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# ANNALS of SURGERY

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Edited by LEWIS STEPHEN PILCHER, M.D., LL.D., of New York
and WALTER ESTELL LEE, M.D., of Philadelphia
Recorder of the American Surgical Association

## TRANSACTIONS OF THE AMERICAN SURGICAL ASSOCIATION, 1933

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ANNALS *of* SURGERY

Vol. XCVIII OCTOBER, 1933 No. 4

# TRANSACTIONS

OF THE

# AMERICAN SURGICAL ASSOCIATION

MEETING HELD IN WASHINGTON, D. C., MAY 8, 9, AND 10, 1933

## ADDRESS OF THE PRESIDENT

## THE STUDY AND TEACHING AND THE PRACTICE OF SURGERY

By Arthur Dean Bevan, M.D.

of Chicago, Ill.

The last fifty years have witnessed great changes in the teaching and the practice of surgery. During this period medicine became a science; medicine is today a science as truly as physics, chemistry and biology are sciences. It is not possible to give an exact date to the birth of the science of medicine but one can approximate the date. The science of medicine is based upon anatomy, physiology, pathology and pharmacology. When these daughter sciences of medicine had advanced to the dignity of true sciences, medicine itself then became a science, because medicine is simply the application of these sciences to the study of the cause and the recognition and the cure and the prevention of disease.

*When did this change occur?* This change, of course, was gradual. Many men in many countries helped to bring it about. In its struggle upward through the centuries mother medicine gave birth to a number of daughter sciences, and these children have helped mightily to place her on a scientific basis. Sired by Vesalius, medicine gave birth first to the science of anatomy; sired by Harvey, to the science of physiology; sired by Morgagni, to the science of pathology; and then these children presented the old lady with many grandchildren. Anatomy gave birth to histology and embryology; physiology to biochemistry; pathology to bacteriology.

If we fix an approximate date to the change of medicine into a science we should, I think, take the period of Pasteur's active work and influence. Many men contributed to this great result before the days of Pasteur: John Hunter, the surgeon; Jenner and the English physicians, Sydenham, Bright, Hodgkin, Stokes and others; Cruveilhier, the French pathologist and the

French surgeons of the last century, Malgaigne, Nelaton and Broca, Claude Bernard, the father of modern physiology; the great French clinician, Trousseau; the introducers of anæsthesia, Morton and Simpson; the German pathologist, Rokitansky, and his contemporaries and successors, Virchow, Karl Ludwig, Langenbeck and Billroth; and then came Pasteur, the founder of bacteriology and through the mist of the centuries at last came clearly into view the magnificent figure of the science of medicine. After Pasteur came Lister and Koch and many laboratory and clinical scientists, and medicine was at last and undeniably a science—possibly the greatest of all sciences.

To those of us who have lived through the greater part of this period of rapid transition, the experience has been most interesting, most fascinating. I began the study of medicine in 1880. It may be of interest if I draw for you a sketch of the surgery of that day. My Professor of Surgery was Moses Gunn, one of the founders of the American Surgical Association, and its fourth President. I soon became an assistant in Gunn's surgical clinic and was the registrar who kept the records of the cases examined and operated upon.

The surgical cases were very different from the cases seen in a surgical clinic today. We did very little abdominal work. We had not as yet introduced antiseptic surgical technic; this in our clinic was not done until 1881. The anæsthetic was ether. The operations performed were amputations, removal of tumors, cutting for stone, excising epitheliomas of the lower lip, operating on hæmorrhoids, opening abscesses, setting fractures, reducing dislocations, occasionally ligating a great vessel for aneurysm, draining an empyema, trephining for depressed fracture of the skull, operating for osteomyelitis, dilating urethral strictures, doing an occasional external urethrotomy for stricture or extravasation of urine, opening a perityphlitic abscess, removing tonsils with a tonsillotome, dividing eye muscles for strabismus, doing subcutaneous tenotomies for club-feet, amputation of the breast for carcinoma, operations for the relief of strangulated hernia, laparotomy for the removal of an ovarian tumor, the tapping of hydroceles and the injection into the sac of tincture of iodine to bring about obliteration and cure, the removal of the second division of the trifacial, including Meckel's ganglion, for severe and persistent facial neuralgia; these were among the operations when I was a medical student.

The surgeons were still under the spell of the rapid and brilliant operating of the pre-anæsthetic era. The left lateral lithotomy done by Gunn and his contemporaries was a dramatic and brilliant piece of work. The patient was etherized and held firmly in the lithotomy position. The grooved sound was passed into the bladder and clicked upon the stone; sitting in front of the patient was the surgeon dressed in a frock coat with the cuffs of the sleeves rolled back; with a scalpel the left lateral incision was made down and into the urethra. The surgeon with his left index finger in the wound felt for the grooved sound; he then passed a long narrow probe-pointed knife along his left index finger down to the staff and felt the point engage

in the groove. He then gave a signal to his assistant who carried the sound well into the bladder by depressing the handle of the staff; this carried the knife with it, and incised the urethra and the left lobe of the prostate. The knife was withdrawn; the left index finger was introduced along the staff into the bladder, the staff was withdrawn by the assistant; the surgeon threw his right hand up in the air and an assistant placed the lithotomy forceps in it; the lithotomy forceps was rapidly introduced along the left index finger into the bladder; the stone grasped firmly by the forceps, a slight rolling motion of the forceps was made to see that the stone was well grasped and that the forceps were free, and then as in delivering a child's head with obstetrical forceps following the curve of the pelvis, the stone was removed and for an instant the surgeon held the stone up over his right shoulder so that the audience could see—and then applause; and all of this was done within a few minutes from the beginning of the operation. The conditions under which this work was done were very different from those existing today.

S. D. Gross, the founder of our Association, in an article published in the American Journal of the Medical Sciences, 1876, volume lxxi, in which he discusses a century of American Surgery (1776 to 1876) made the following surprising statement:

> "Although this paper is designed to record the achievements of American surgeons, there are, strange to say, as a separate and distinct class no such persons among us. It is safe to affirm that there is not a medical man on this continent who devotes himself exclusively to the practice of surgery. American medical men are general practitioners, ready, for the most part well educated, to meet any and every emergency whether in medicine, surgery or midwifery."

This situation continued for some time. Dr. George Dock, who was graduated in the 'eighties in Philadelphia, told me that W. W. Keen, who at that time was recognized as one of the prominent American surgeons, had one of the largest general practices in Philadelphia, and Nicholas Senn, when he left Milwaukee to take the chair of surgery at Rush, was doing a very large general practice.

One can obtain some idea of the surgery of the time by reading the first volume of the Transactions of the American Surgical Association, published in 1883, fifty years ago. This contains the papers read in the first three meetings. Although Lister's paper on the antiseptic treatment in surgery was published in 1867, his suggestions were very slowly accepted. Lucas-Championniere in France, and Thiersch and Volkmann in Germany adopted Listerism in the early 'seventies. Lister's work was based at first upon the theory that germs produced suppuration and he sought to exclude them from the wound. This was simply a theory; these pus germs were not demonstrated until Ogston in 1881 and Rosenbach, somewhat later, and Koch finally with solid media were able to grow pure cultures of staphylococci and streptococci and prove conclusively the fact that these pus organisms were the cause of suppuration.

In this uncertain period of about fifteen years, the majority of the surgeons of the world refused to accept Lister's theory. This is very well shown in the first volume of the Transactions of the American Surgical Association. Dr. B. A. Watson, of Jersey City, read an excellent paper on Lister's system of antiseptic wound treatment. Today, of course, the paper seems most convincing and yet the discussion which followed showed that many surgeons refused to accept it. Dr. J. H. Packard, of Philadelphia, who opened the discussion, said, "If I understand the essayist correctly, I must take exception to his statement that the majority of American surgeons have adopted Listerism; certainly on behalf of the surgeons of Philadelphia I feel warranted in saying that it has not in their hands yielded such results as to induce them to adhere to it." Dr. Alfred Post, of New York, said, "I think I can say the same in regard to the surgeons of New York; I do not think that any of them now use the method." Dr. A. Vanderveer, of Albany, said, "I can say the same in regard to the surgeons of Albany and the vicinity." Dr. T. G. Richardson, of New Orleans, said, "There is not a surgeon in our state who uses the Lister method." Dr. C. H. Mastin, of Alabama, said, "We have ceased to use it entirely"; and this was the American Surgical Association in 1883.

Fortunately, my own teacher of surgery, Moses Gunn, took up Listerism comparatively early. In the first volume of the Transactions of the American Surgical Association, he presented a paper on the treatment of fractures of the skull; this was read June 1, 1882. Up to that time the accepted treatment in fractures of the skull with depression was to operate and elevate the fragments in compound fracture, but to leave simple fracture with depression severely alone. Gunn took the position that the advantage gained by antiseptic surgery made it possible to operate with safety on simple fractures with depression and elevate the fragments, and he advocated this method of treatment. Gunn was severely criticised. One surgeon in the discussion said, "I think the advice of Doctor Gunn, that we should elevate every depressed fracture, even if it is simple in character, is a very dangerous doctrine."

During my medical course our school, fortunately, came under the influence of two of our younger men who had spent several years in post-graduate work in Vienna and Berlin, France and England, during this period of rapid transition from 1880 to 1882. These men were William T. Belfield, who just before his return from abroad studied in Koch's laboratory in Berlin and learned what was then known of the new science of bacteriology; he learned to stain for tubercle bacilli, gonococci, pus organisms, *etc.* Belfield presented in the Cartwright lectures in New York in 1883 an excellent account of the known facts of that day under the title of "The Relation of Microörganisms to Disease." I was fortunate enough to receive instruction in this new bacteriology from Belfield—a course which he gave to a small group of six of us as a private course.

The second man I refer to was Roswell Park, who was at that time an

assistant professor of surgery under Gunn. Park delivered the Mütter lectures on surgery in Philadelphia in 1890 and presented very well the newer conceptions of surgical pathology and especially surgical bacteriology. Park did not remain with us very long. On Gunn's recommendation he was called to the chair of surgery at the Buffalo Medical School where he became, as you all know, one of our great surgical teachers.

In my medical course I majored in anatomy. For three years I was prosector to Professor Chas. T. Parkes, who was a fine anatomist and a brilliant surgeon. Parkes early took up antiseptic surgery and mastered the technic so thoroughly that he obtained excellent results. In 1884 and 1885 he did a series of experiments on forty dogs producing gunshot and penetrating wounds of the abdomen after the dogs had been etherized and prepared antiseptically for a surgical operation. He operated at once, opened the abdomen, controlled the bleeding, repaired the injury of the stomach and intestines and other viscera and succeeded in saving about 50 per cent. of the cases. He presented this work as the Chairman's Address of the Surgical Section of the American Medical Association in 1885. His paper attracted wide attention all over the world and was followed at once by many successful operations for penetrating wounds of the abdomen in this country, England and the Continent; Parkes' work was timely. It was made possible by the combination of antiseptic surgery and anæsthesia and improved surgical technic.

The period from 1880 to 1890 proved to be in surgery one of great activity and marvelous development. It witnessed the development of the operations for radical cure of hernia, resection of the stomach for carcinoma, gastroenterostomy for the relief of pyloric obstruction, cholecystectomy and choledochotomy, the removal of kidney stone, the discovery of appendicitis, the operation of appendectomy and new operative procedures in almost every anatomical field made possible for the first time in the history of the world by the fortunate combination of anæsthesia and antisepsis. It was, of course, as the senior members of the association can testify, a wonderful opportunity to live through this period of the development of modern scientific surgery.

After I was graduated I entered the U. S. Marine Hospital service and was stationed for a time in Portland, Oregon. While there I did the modern operation for radical cure of hernia; first, the Czerny and later the Bassini operation; cholecystotomy and cholecystectomy for gall-stone disease; gastroenterostomy; nephropexy and nephrectomy; and later after McBurney's report early appendectomy and removal of the inflamed appendix before an abscess had formed; resection of the second division of the fifth nerve with Meckel's ganglion. These were among the early operations of this kind done on the Pacific coast.

In 1888, after Gunn's death, Charles Parkes was made Professor of Surgery and I was called back to Rush as Professor of Anatomy. At that time the chair of anatomy was often the stepping stone to the chair of surgery.

I felt my deficiencies, especially in histology and embryology, pathology and bacteriology, and planned a post-graduate course abroad in these subjects and in surgery. I did this in 1892 and 1893. I went first to the old Cohnheim laboratory at Leipzig, then in charge of Birsch Hirschfelt (Schmorl was at that time his first assistant). Carl Ludwig was the Professor of Physiology. The great embryologist, His, was then Professor of Anatomy, and I had a very satisfactory course in anatomy under Spalteholtz, who was one of his assistants. Thiersch was the Professor of Surgery. From Leipzig I went to Vienna and entered as a student in Billroth's clinic. Eiselsberg was Billroth's first assistant and gave us a fine course in operative surgery on the cadaver.

Billroth was a great teacher. One who attended his clinic could well understand why he had developed so many great surgeons and had filled so many of the surgical chairs of Germany, Austria and Switzerland with his pupils. I early obtained a copy of his book, Lehren und Lernen, and have read it and re-read it many times. Although it was written in 1876 I regard it as one of the soundest and most logical schemes of medical education that has ever been formulated; it will well repay every teacher of medicine and surgery to study it thoroughly. It was translated and published in English in 1924 with an interesting introduction by Professor William H. Welch under the title of "The Medical Sciences in the German Universities."

In teaching surgery Billroth trained his students in anatomy, physiology and pathology as the basis for his teaching in clinical surgery; his surgical teaching was done in the out-patient dispensary, the hospital and the surgical clinic. His conception was that the student was an apprentice who was to learn by seeing and helping the master and his assistants in the diagnosis and handling of patients. He taught his students surgery as a successful football coach teaches his squad football, by training them in the actual work itself. He would have had very little patience with some of the modern makers of medical curricula, who take the position that the student is to be given a cadaver and a book or a patient and some books and be left to educate himself. His course on principles of surgery, his courses on surgical anatomy and surgical operations on the cadaver, his laboratory course on surgical pathology and his surgical clinic covered thoroughly the ground. He, himself, taught ten hours a week and he made his own surgical clinic the backbone of the surgical course. The professor of surgery in our American medical schools might well adopt Billroth's scheme of organizing his own surgical department.

In looking over the literature of the period when I began the study of medicine, in order to visualize the surgery of this time, I find nothing that compares with a publication of Billroth's in which he reports the work which he did in his surgical clinic at Zurich and his surgical clinic in Vienna from 1860 to 1876. (Chirurgische Klinik, Dr. Th. Billroth, Berlin, 1879.) In the introduction of this volume I find an incident which will interest the members of the American Surgical Association:

Billroth says, in his introduction, "One morning while I was giving a clinic on Lymphoma and presenting the subject in a forceful way to the class, I noticed on the upper row of seats in the crowded amphitheater an elderly gentleman with a fine head and stately figure. In the course of my talk our eyes met and we exchanged several times sympathetic glances. At the close of the clinic he came down into the amphitheater and introduced himself as Professor S. D. Gross, of Philadelphia, the most eminent surgeon in the North American republic and one of the most honored citizens of his country. He held out his hand and said, 'You have presented this subject to your students in the most truthful way, in a way that is seldom done.'" Billroth said that he treasured this meeting and this compliment throughout his life.

In this report of his clinical cases, Billroth gives a very interesting account of his efforts to study and improve the treatment of wounds; a subject to which he devoted much time and study. As early as 1874 he published a research on the vegetation forms of cocco-bacteria septica and the part which they play in the causation and spread of accidental wound infection; a research on the various methods of antiseptic wound treatment. This is illustrated with plates showing various cocci and streptococci and bacilli. During the sixteen-year period covered in Billroth's report he handled 9,508 cases and had 785 cases of erysipelas and pyæmia and a few cases of tetanus, making about 8 per cent. of accidental wound infections. Of 1,076 patients who died 477 died of wound infection.

He operated on seventy-seven cases of breast carcinoma where he removed the mammary gland and the axillary glands; of these seventy-seven cases twenty-four died, three from secondary hæmorrhage, one from pneumothorax on the evening of the operation and ten each from erysipelas and pyæmia. In his report on his amputations, resections and osteotomies of the extremities, he operated on a total of 214 cases; of these 150 recovered and sixty-four died: nine from collapse, three from erysipelas, two from delirium tremens, and fifty from septicopyæmia—a mortality of 29.9 per cent. Billroth reports that up to February, 1879, he had done 140 ovariotomies; of these eighty-three recovered and fifty-seven died (a mortality of 40.71 per cent.). With this terrible mortality we wonder how the surgeons of 1880 had the courage to continue to operate. What a marvelous revolution was brought about by Lister! What a change came with the general introduction of sound antiseptic surgery!

This change really occurred throughout the world in the ten-year period from 1880 to 1890. The change began with Pasteur's discovery in 1861 that fermentation and putrefaction were due to microörganisms and to Lister's conception in 1867 that wound infections were due to these same microörganisms. Lister's first attempts were directed to sterilizing everything that came in contact with the wound, even the air. Lister's work remains today the most important discovery in the development of scientific surgery.

In about 1886 the aseptic method began to displace the original antiseptic technic. It became more and more evident that clinical infection meant as a rule contact infection and that air infection was rare. The

spray was given up and disinfection with carbolic acid was displaced by disinfection with heat. This simplified and improved the entire method. Von Bergmann and one of his assistants, Schimmelbusch, contributed a good deal to this new aseptic surgery. Suddenly it seemed almost as if by magic the tragedies and terrible pictures of post-operated deaths from wound infection, such as Billroth reported in 1879, disappeared and a new and wonderful scientific surgery was born. Chas. T. Parkes, who succeeded my old teacher, Gunn, in the chair of surgery, was able to report in 1888 twenty-five laparotomies done before a large class in a huge teaching amphitheater without a wound infection and with only two deaths. In this new development of modern scientific surgery America played an active and creditable part.

*The Teaching of Surgery.*—The American Surgical Association, in addition to its scientific work, has a most important function to perform as an Association composed of the teachers of American surgery, a function which I believe it has done and is doing well.

I began my teaching work at Rush in 1888 as professor of anatomy, devoting about half my time to my college work and the rest to surgical work at the Presbyterian Hospital. The next ten years were years of very active development in surgery. In 1898, Rush became a part of the University of Chicago and under the inspiring leadership of President William R. Harper began a reorganization along university lines. We secured Lewellys F. Barker, who was then in the anatomical department with Mall at Johns Hopkins, to take the chair of anatomy, and I was made Associate Professor of Surgery under Senn. In 1900 I became a member of the American Surgical Association. During this period we were studying eagerly the subject of the reorganization of medical education at the University of Chicago. In 1902 I was made Chairman of the Committee on Medical Education of the American Medical Association, and in 1904 we succeeded in having created the Council on Medical Education of the American Medical Association.

In previous years this committee had brought in a formal annual report which was read and published in a routine way but little had been accomplished. Fortunately, we had an active, strong committee which devoted a good deal of study to the problem and we brought in a report advocating the establishment of a more permanent committee, each member to serve for five years. We asked for a salaried secretary and enough funds to carry on an active investigation throughout the year. In 1904 we succeeded in having created a Council on Medical Education of the American Medical Association along these lines. Our committee's investigations had shown the necessity of a national influence and control of medical education and we found that this control could not be exercised by the Federal Government. We, therefore, recommended that the American Medical Association create a Council on Medical Education to exert such national influence and control.

From 1904 until 1928, when I retired as Chairman of the Council on Medical Education, I devoted a great deal of my time to this work. We formulated a program which aimed to secure in America a pre-medical course of two years in physics, chemistry and biology in the university, four years in the medical school and an interneship of at least a year in the hospital. In less than twenty years we succeeded in putting this program into effect. We reduced the number of medical schools from 160 to eighty. We cut the number of medical students in half. We eliminated twenty homeopathic schools and ten eclectic schools by securing the general acceptance of the preliminary requirements of physics, chemistry and biology, and converted almost all of the schools that survived into medical departments of universities.

The reorganization was more thorough and more complete than we had even dared to hope. We secured the coöperation of President Pritchett, of the Carnegie Foundation, and also the coöperation and enormous financial assistance of the Rockefeller Foundation and the General Education Board through President Vincent. We secured the active support of the State Examining Boards and of the Association of American Medical Colleges. The success of the reorganization of medical education in this country was in large part due to the coöperation of these various agencies with the American Medical Association.

Samuel P. Capen, Chancellor of the University of Buffalo, read a paper before the Annual Congress on Medical Education and Licensure, held February 13, 1933, in Chicago, in which he said, "No other phase of American education has ever been so drastically reformed in so short a time as was medical education. In 1904 the vast majority of medical schools were, with respect to requirements for entrance and instructional procedure, scarcely above the level of trade schools. By 1918 medical education had been generally transformed into a university enterprise; on the whole the most consistently excellent enterprise that the universities conducted. The Council on Medical Education reformed not medical education alone; through the influence of its example it has brought about the general reform of professional education."

In this work of the reorganization of medical education the members of the American Surgical Association gave generously of their support; many of them took an active part in the work, notably Frazier and Haggard, who were for some time members of the Council, and Fred Lund, Harvey Cushing, John Finney, William J. Mayo, Dudley Allen, Joseph Blake, Herbert Burrell, Frederic Gerrish, William S. Halsted, Rudolph Matas, Lewis McMurtry, William Rodman and Herry Sherman, who served on various committees and formulated the organization of surgical teaching.

*The American Surgical Association.*—The membership of the American Surgical Association is at present limited to 150. This year there was but one vacancy created by the death of an active member. The officers

of the Association succeeded in persuading nine active members to change their status to senior members. Is it fair to ask comparatively young members to do this? The United States and Canada are steadily increasing in population. The number of unusually competent surgeons, men who from every standpoint are entitled to membership in our Association, is increasing very rapidly from year to year. Would it not be well to make some provision at this time for a gradual increase in our membership? I would suggest that in addition to filling the vacancies that occur each year, we add for the next five years five new men each year. This plan would in five years increase our membership to 175, a number which is quite safely within the limits of our conception of a strong representative surgical association, representing both this country and Canada. I hope that the Association will look favorably into the matter of such gradual increase and take the necessary action to bring it about. I believe that such a step will strengthen our Association.

Gradually in the last fifty years the practice of medicine has become more and more divided into *specialties*. I have already referred to the fact that the founder of our Association, Samuel D. Gross,, stated in 1876 that "it is safe to say that there is not a medical man on this continent who devotes himself exclusively to the practice of surgery and that American medical men are general practitioners and cover the entire field of medicine, surgery and obstetrics." This condition has been greatly changed. There are today in the United States about 160,000 practitioners of medicine. The Register published by the American Medical Association gives the age of the physician, year and school of medicine from which the medical degree was received and the state granting the license to practice medicine, and also states whether the physician specializes in any specialty and whether he limits his work to that specialty. Of these 160,000 physicians 47,390 state that they are specializing in some special field and 24,391 state that they limit their practice entirely to that special field. You may be interested to know that in surgery 3,998 men limit their practice to general surgery, and that 8,550 devote special attention to surgery; 200 men limit themselves to industrial surgery and 734 devote special attention to industrial surgery; 604 men limit their practice to orthopædic surgery and 281 devote special attention to orthopædics; 190 limit their practice to proctology and 346 devote special attention to it; 1,326 men limit their work to urology and 1,024 specialize in it; a total of 17,253 limit or specialize in general surgery, industrial, and orthopædic surgery and proctology and urology.

There can be no doubt but that medicine has been advanced by men who have specialized in limited fields; and the right sort of specialism and the right sort of specialists should be encouraged and maintained. On the other hand, half-baked specialists and commercial specialism are a definite menace to both the profession and the public. This problem is not new. In an address on specialism in 1892 Osler said, "No more dangerous members of our profession exist than those born into it, so to speak, as specialists." It

requires fully as much or more intelligence and training to become a competent practitioner in general medicine or general surgery as it does to become a specialist. There is a growing demand on the part of the public for specialists in medicine, and many medical men go into specialties because of this fact—because it pays. Many of our 47,000 specialists in this country have not had the training and experience that would warrant their posing as specialists.

This has presented a difficult problem to solve. A man who is licensed by a state to practice medicine can, of course, cover the entire field of medicine, and this right should not be restricted in any way. There should be, however, some means found to protect the public against illy prepared specialists; or at least an effort made to designate in some way properly trained specialists. The minimum requirements for the training of a specialist can probably be agreed upon as graduation from an accredited medical school, at least one year as an interne in an accredited hospital and then several years in general practice of medicine or surgery and at least three years' training in the specialty in an accepted hospital and under the instruction of a recognized specialist; a Master's Degree might be granted for such work well done. This degree, however, would probably not go very far in solving the problem or at least not far enough. To my mind the most effective way would be to call to our aid the concerted action of our better hospitals. More and more the well-organized and well-conducted hospitals are becoming the centers of the medical activities of our communities. Most specialists need good hospital facilities to carry on their work. If we could succeed in having the American Hospital Association and the American Medical Association act in this matter and secure the united action of the organized medical profession and all of our best hospitals in demanding the proper training for all the men appointed as attending men on their hospital staffs and demand a minimum of three years of special training for men posing as specialties, it would go far toward protecting the public, the profession and the hospitals and eliminate much unnecessary work and work done by incompetent men. Within the last twenty-five years, and especially since the war, there has been a tendency to split general surgery into many specialties.

The *scope of the field to be covered* by the American Surgical Association has never until comparatively recently been a matter of question. Since the founding of the Association in 1880, it has always been the purpose of the organization to cover the entire field of general surgery. In the last twenty years there has been a tendency to split off first one and then another and another anatomical region and develop it into a surgical specialty. This has been due, in part at least, to the development of some new instrument of diagnosis, such as the laryngoscope, the cystoscope, the proctoscope or some new procedure in management as plaster-of-Paris fixation in orthopædic cases, or X-ray and radium in the treatment of malignant disease and other lesions. In some instances, as in neurosurgery, it has been due to the

special preparation in diagnosis and the special operative technic required in the development of a new and difficult field. We all, of course, welcome these new instruments and methods for they have increased our knowledge and power.

There is, however, an unfortunate side to this problem. The special technical training involved in these new instruments and methods has led to the development of specialties and specialists and a tendency to separate these fields entirely from general surgery and to the training of young men in these limited fields without receiving first a broad general surgical training. The first men who developed these surgical specialties were general surgeons with a broad surgical training which made them safe men to handle this special work and other conditions involving other parts of the human body which often have to be recognized and dealt with in the proper treatment of the individual case In some of these surgical specialties today young men frequently go direct from the medical school, or after a short hospital interneship, into some surgical specialty which involves a narrow field, a single organ or a group of organs. This is not the best organization of surgery and surgical teaching. We should insist upon a broad training in general surgery as a prerequisite to entering a surgical specialty.

Another phase of this question must interest us as members of the American Surgical Association. Gradually as these surgical specialties have developed and special societies in these subjects have been formed, there has been a tendency to cut off entirely from general surgery these special fields. This has already been carried very far. What would become of general surgery if the head, spine and peripheral nerves were lopped off by the neuro-surgeons, if the specialists in thoracic surgery took over the chest, if urologists took over the genito-urinary organs, proctologists the rectum and colon, orthopædic surgeons fractures and dislocations and the extremities, and plastic and oral surgeons appropriated their own special field? The gynecologists and obstetricians have for a long time claimed the female genito-urinary tract as exclusively their own. This would leave to general surgery nothing except that small part of the body between the diaphragm and the umbilicus; and now comes another claimant into the field, the tumor specialist or the cancer specialist. I have no hesitation in denouncing this last as a very serious blunder. We might just as well develop specialists in inflammation of all parts of the body as to train men as specialists in cancer involving all parts of the body. Within the last year I have met several of these men who pose as being specialists in the recognition and surgical treatment of malignant disease, no matter in what anatomical region it occurs. Of course, any man who is licensed to practice medicine has the right to devote himself to any field he desires.

Let us look at this subject from the interests of the great science of surgery, of the American Surgical Association and the interest of the public. If we do this I am confident that we shall all agree that surgery must remain intact as a great science covering the entire body, and that the Ameri-

can Surgical Association in its work in its programs should cover the entire field of general surgery. Much of the best work done in these special fields, in brain work, in bone and joint work, in genito-urinary surgery, in thoracic surgery, in plastic surgery, has been done by members of the American Surgical Association; and many of the leaders in these fields are here with us today. We should maintain this leadership. We should welcome as members groups of outstanding men who have developed in these various special fields. We welcome the advances made by intensive study of special surgical fields; but in the interest of the future of both general surgery and the surgical specialties, general surgery must be kept intact and broad enough to cover the entire subject, and it must continue to act as the great teacher, the great stabilizer of all fields of surgery. In the teaching hospitals, in the university medical departments and in the group clinics, it is clearly right and proper, and to the best interests of the science of surgery, that men well-trained in general surgery should devote themselves to special surgical fields; but the bulk of the surgery of the country will continue to be done, and will be well done, by surgeons who have been trained in general surgery and who practice general surgery, and a thorough training in general surgery will continue to form the basis of the training of both general surgeons and surgical specialists. This subject presented itself as an acute issue during the World War. While working in the Surgeon General's office in Washington I was requested by General Gorgas to make a study and report on the relations of general surgery to the surgical specialties. I later read a paper covering this ground at the meeting of the American Surgical Association in Cincinnati in 1918, and this was published in vol. xxxvi of the Transactions under the title, "Coördination of General Surgery and the Surgical Specialties."

The American Surgical Association is composed largely of teachers of surgery. In addition to our interests in the science and art of surgery, the American Surgical Association has other important *functions to perform.* We must teach our young men the importance of accepting a code of ethics, a code of morals, which will insure the highest character to all their actions in their surgical work. We must teach them to develop a judicial attitude. As surgeons they are often the court of last resort; we are called upon to decide questions which involve the life and the health of the patient. These questions must be answered in the safest, most logical, most judicial and the most scientific way. We must teach them that there is an art of surgery which they must master. We must teach them that one of the most important things in the practice of surgery is the practice of common sense.

We can all be proud of the great developments that have been made in surgery since the founding of the American Surgical Association in 1880. We are proud of the contributions made to this wonderful development by members of our Association. I have sketched for you hastily the story which the swiftly moving finger of time has written in the last fifty years. We have accomplished much but we are but at the beginning of our task.

The mighty future holds for the science of medicine, for the science of surgery the greatest possibilities of development, the greatest possibilities of good. The men of our generation will pass on the torch to younger and stronger hands. They can feel, however, as one by one they fall out of the ranks, that they have served the science of surgery and their country well and they cannot find fault with the fates for they have been most fortunate; they have had great opportunities; they have lived in the most productive period of medical history. As we grow older we find that there are compensations which come with the marching years.

There is beauty in the sunset, a golden coloring in the autumn. A wider vision comes, a kindlier feeling toward the comrades who are marching with us along the same road; a great joy, a great pride in the young men we have trained; a keener appreciation of life with all its possibilities; a greater joy in living. We learn to overlook and forget the little things that once irritated and annoyed us. We learn that no one can injure us but ourselves. We learn the simple and wonderful lesson of the Golden Rule. We learn to recognize and bow down before the immutable laws of the universe. We are but atoms in a mighty scheme, but small as we are we are a part of it, and whether we will or not the good and the bad of our lives will live on. Scientists as we are, we learn from science the laws of life, the laws that men must follow for their own good. We learn that the physical law and the moral law are one. Define these as you will, such knowledge means a religion. Let us make a confession of faith in life in science in the future, in our fellow men.

# UNDESCENDED TESTICLE

## A COMPARISON OF THE END-RESULTS OF TOREK'S OPERATION AS CONTRASTED WITH THE FORMER METHODS OF OPERATION

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In 1926, we reviewed the operations for undescended testes at the Ruptured and Crippled Hospital and were so discouraged with our end-results that we sought some better method of operating. Torek's results by orchiopexy, bringing the testis out through an incision in the scrotum, anchoring it to the fascia of the thigh, and suturing the margins of the scrotal wound with those of the thigh, were so satisfactory that we tried his method, first in selected cases, and being so pleased with the results have adopted it as the routine procedure during the past five years both at the Ruptured and Crippled Hospital, The Children's Surgical Service at Bellevue Hospital and at the Lincoln Hospital.

Torek first published "The Technique of Orchiopexy" in 1909, and Meyer, in 1927, reported on sixty-four cases which had been performed by Doctor Torek and his associates up to that time. Their results were all satisfactory, a record which we unfortunately cannot equal, but as our patients have been operated upon by a fairly large staff at each hospital the results may more nearly represent what the average surgeon may expect to accomplish. No other clinic has reported any considerable number of cases and we firmly believe this operation should become more popular than it is today. We have not infrequently operated upon cases by the older method in which we felt at the time that the cord had been sufficiently lengthened to permit the testis to lie free in the bottom of the scrotum. However we learned that it frequently retracted even as high as the external ring. We agree with Torek that the stretching and development of the scrotum is the factor that prevents retraction of the testis when the cord has seemed of sufficient length.

*Age of Operation.*—We still believe, as stated in our previous article, that the most suitable age for operation is between eight and twelve years. This gives the testis a good chance to descend voluntarily if it will, it is larger and easier to manipulate and the structures are more easily identified than in younger patients. Also the organ has been placed in its normal position before the changes which come with puberty occur. If the undescended or mal-descended testis is accompanied by a large hernia, we feel an earlier operation is imperative as naturally retention of the hernia by a truss is sure to exert pressure on an already underdeveloped organ and would also prevent any tendency to normal descent. Moreover, the continued trauma of a truss may theoretically at least predispose to malignant change in the

undescended testis which statistics have shown is of itself more prone to such degeneration than the testis normally situated. Truss treatment is therefore contraindicated. In mal-descent, especially when the testis is directed into the thigh instead of the scrotum, we usually advise operation earlier as further descent does not aid the testis in reaching the scrotum.

*Operative Technic.*—The usual incision as for an inguinal hernia is employed. In carrying this incision through the superficial fascia it is important to realize that we may be dealing with a sac of the superficial inguinal type which after its emergence from the external ring turns upward toward the anterior superior spine and lies on the aponeurosis of the external oblique just beneath the deep layer of the superficial fascia. If this possibility is not borne in mind a hasty incision may result in damage to the testis or vas. In cases where the testis has never escaped through the external ring this latter may be very small and difficult to identify. Rather than spend too much time in trying to identify it we believe it is simpler to make an incision in the aponeurosis of the external oblique from above downward, terminating immediately over the spine, which is the point where the external ring is located. Having reflected the aponeurosis and exposed the inguinal canal the cremaster is split in the direction of its fibres and the sac, vessels and testis delivered, the vessels and testis lying apparently within the sac. The latter is now opened near the internal ring but sufficiently distant from it so that in case the sac is torn during the separation of the vessels it will be readily recognized before the tear has extended within the ring. By making gentle traction on the testis, either by means of a clamp attached to the gubernaculum or by surrounding it with gauze, the sac and vessels are put slightly on the stretch. This tension brings out the natural cleavage planes between the sac and the vas and vessels which are spread out on the posterior surface of the sac. Clamps are placed on either side of the opening in the sac and the vessels and vas are separated from it by displacing them posteriorly, working with blunt-pointed scissors in the areolar tissue which lies between the sac and infundibuliform layer of fascia, the latter uniting the cord structures to the sac. Having cut across the sac the next and most important step is the separation of the upper end from the vessels. This procedure is simplified by putting a blunt retractor within the internal ring and lifting it upward, thereby facilitating a higher separation and breaking up all the adhesions between the vessels and the peritoneum anteriorly and the abdominal wall posteriorly. The sac is now transfixed and ligated and the redundancy excised. This procedure cures the hernia. The lower end of the hernial sac is excised close to the testis and all fascial bands between the internal ring and the testis including the gubernaculum are removed so that the vas and the vessels of the cord are denuded of their coverings. Doctor Torek especially emphasizes this step and we think some of our failures may have been due to lack of thoroughness in this procedure.

If the vessels are still too short, division of the spermatic artery and vein as recommended by Bevan are to be considered, but in both Doctor Torek's and our own experience this has not been necessary. Most surgeons who have divided the vessels and have followed their patients have been impressed by the fact that the testes usually atrophy and may even disappear entirely. (Figs. 1 and 2.)

An oblique incision about one inch and a half long is now made on the inner surface of the thigh at a site where the testis lies without undue tension and the fascia lata exposed, care being taken not to injure the internal saphenous vein. Torek recommends that this incision should be made from in front backward and slightly downward so that the apposition of the scrotum and thigh is a more natural one and the tension is slight and evenly distributed along the entire suture line. A pocket is now made in the bottom of the scrotum which is distended with gauze and incised, the incision corresponding in length and direction with that of the thigh. That the inner limit of this incision should be the median raphe. The posterior lips of the two incisions

are now sutured together. Torek advises using interrupted sutures of catgut and states that this step is the most difficult in the entire operation due to the difficulty of preventing inversion of the two skin surfaces. We feel that we have simplified this step in inserting temporary traction sutures at the two angles and using a continuous suture of

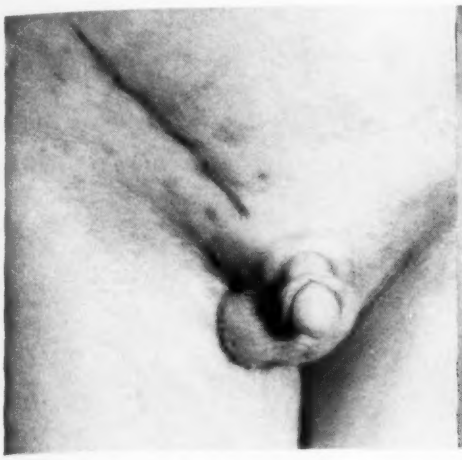

FIG. 1.

FIG. 2.

FIG. 1.—Two months after first stage. Testis in scrotum.
FIG. 2.—Double undescended testes. Anastomosis made too low on right. Testis buried in thigh and difficult to palpate.

a subcuticular type. A firm bite is obtained in the subcutaneous tissue but the skin is transfixed as in a subcuticular stitch which avoids the complication of inversion and favors approximation of the two skin surfaces. After the posterior margins have been sutured the traction sutures are removed. The testis is now brought down through the

FIG. 3.

FIG. 4.

FIG. 3.—Second stage right, first stage left. When the right testis was delivered from thigh it was found to be normal in size.
FIG. 4.—Left undescended testis. One year after second stage.

scrotal wound and sutured with two or three interrupted chromic sutures to the fascia of the thigh, enough of the tunica albuginea being picked up to give a good hold. The anterior margins of the thigh and scrotal wounds are sutured with a continuous silk suture, care being taken to get good approximation especially at the angles. The inguinal hernia is repaired in the usual manner without transplanting the cord. A strip

of vaseline gauze is passed through the canal of skin between the scrotum and the thigh which serves as a dressing for the deep sutures.

While Torek does not recommend it, we feel more secure if the knees are strapped together to prevent tension on the suture line.

The skin of the scrotum and thigh are quite different in character and in our experience union does not take place as promptly as in a simple incision, consequently we do not remove the sutures until the ninth or tenth day. Frequently we do not have perfect approximation at the angles and there may be a small granulating wound at these sites which heals in a few days. The patient is usually out of bed on the twelfth day and discharged at the end of two weeks.

We agree with Torek that the post-operative course is uneventful. These individuals are perfectly comfortable, are able to indulge in all activities which a normal person might and do not complain of any drag on the scrotum or suffer from eczema.

The second stage releasing the testis from the thigh is indicated as soon as the scrotum has stretched out to near the normal size, which is usually from two to three

FIG. 5.

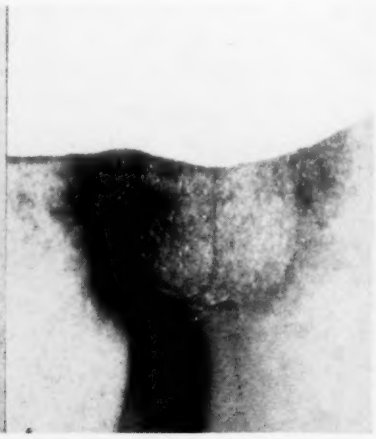

FIG. 6.

FIG. 5.—Operation six years ago by former method. Left testis at external ring. On right side vessels divided and testis atrophied. Result after Torek on left side one year ago. Testis in bottom of scrotum and normal in size.
FIG. 6.—Double undescended testes. Result three years later. Operation in three stages. Normal-sized testes in bottom of scrotom.

months. If this is not a convenient time, as is frequently the case in school children, we put off the second stage until the summer vacation or some other suitable period. A boy sixteen let three years elapse between his first and second stages. During this time he led a normal life and entered into all the school activities which he would have if his testis lay in its normal position. (Figs. 3 and 4.)

Separating the testis from the thigh is a rather delicate operation and care must be taken not to incise or injure the organ. We recall one instance in which, to be sure we had sufficient skin to cover the testis, we removed some of the skin of the thigh and sutured it over the testis. This thigh skin promptly sloughed—why, we cannot say—but since then we have been careful to make our incision through the skin of the scrotum and have not had any difficulty in covering the testis without tension. The sutures are removed in a week and the patient discharged on the same day. (Figs. 5 and 6.)

In patients with bi-lateral undescended testes our usual procedure is to bring the testes down one at a time. At the second operation the first testis is released and the second brought down, the latter being released at the third operation. While Torek advised against bringing them down at the same time due to the increase in tension between the scrotum and the thighs one of us (Coley) in three cases has performed the

double operation in two stages with satisfactory results. As a routine procedure we feel the three-stage operation is probably safer.

*Results.*—In our previous article the results as regards location of the testis were about 50 per cent. satisfactory. These included nearly a third which were in the upper scrotum, which we would now consider, a position unsatisfactory. Our percentage of normal sized testes was about 15 per cent. (Figs. 7 and 8.)

Charles Mixter reported in 1924 a series of 207 cases in which the end-results were noted in sixty-one. His percentage of good results both as to location and size of testis were 79 per cent. satisfactory. These statistics are distinctly better than ours, but are based on only 30 per cent. of his total operations.

FIG. 7. FIG. 8.

FIG. 7.—Double undescended testes. Both sutured to thigh at first stage.
FIG. 8.—Both testes released at second stage. Result two months later.

Bevan in his last article does not give his percentage and we are not familiar with any other larger series of end-results.

In reviewing our Torek operations we are impressed with the fact that many times a testis which was only one-half or two-thirds normal in size at the first operation has developed in the thigh, and at the second stage approximates the normal. Others that are not normal at this stage continue to develop in the scrotum and a follow-up note a year later states that the operated testis is the same size as its fellow. Not infrequently a testis buried in the thigh is difficult to palpate and its actual size cannot be appreciated. In several instances where we thought it was greatly atrophied, we have been agreeably surprised to find, after dissecting the organ from its bed in the thigh, that it had developed to normal proportions.

There may be some slight delay in healing at the angles of the wound due to faulty skin approximation. This seldom causes trouble, but if an infec-

tion supervenes the scrotum takes longer to stretch out because of the scar tissue and it is wiser to wait a longer period before advising the second stage. If attempted before the scrotum has stretched sufficiently it may be difficult to cover the testis due to a deficiency of scrotal skin. After the first stage the testis usually lies in the thigh, but may pull away and remain in the lower scrotum; either position gives as satisfactory final result.

We have previously stated that these children are perfectly comfortable, between the first and second stages, but we must report one catastrophe which happened to a child of fourteen, who lived in an adjacent city. He was awaiting the second stage and his physician reported that while playing in the street he suddenly experienced pain in the left inguinal region. This continued for several days when he was operated upon and an early gangrenous testis removed. Torsion of the cord would seem to be impossible with the testis anchored in the thigh and it is difficult to understand how trauma could have caused sufficient disturbance to the circulation to permit gangrene. We are at a loss to explain the etiology.

We have 137 completed cases for a final analysis. In 123 the results are excellent, the testis is normal in size and lies free in the bottom of the scrotum. In fact, the scars in the groin and thigh are the only evidences of a previously undescended testis.

Our failures were due to technical errors, sufficient care was not used in dividing all the fascial bands or the vessels were not sufficiently mobilized to permit the testis to be sutured to the thigh without tension. In a few cases the scrotum was sutured to the thigh in a position which caused too much tension on the suture line so that the scrotum partly or completely separated from the thigh.

Five testes sloughed, two of these were sutured to the thigh without tension but the suture line became infected and the scrotum separated completely from the thigh. This separation plus the infection undoubtedly caused the sloughing. The other three were sutured to the thigh under too much tension.

Nine are reported as atrophic, in three the atrophy was complete. One patient was discharged with a testis nearly normal in size but a follow-up note one year later stated that the testis had atrophied and could not be palpated. This is our only record of a case of atrophy in a testis approximately normal in size. The others varied from one-third to one-half normal. We attribute this atrophy to interference with the blood supply from too much tension on the vessels. In no case were the vessels of the cord deliberately sacrificed.

*Conclusions.*—Failures by Torek's method of orchiopexy can usually be attributed to some technical error. The end-results in our hands are so far superior to those which we obtained by the former methods that we do not feel justified in using any other type of operation.

Discussion.—Dr. Bradley L. Coley (New York) said that any discussion of the surgical treatment of undescended testis should be prefaced by a word of appreciation of

the pioneer work done in this field by Doctor Bevan. His operation will stand as the classical procedure for this condition, comparable to that of Bassini in inguinal hernia.

About twenty-five years ago Doctor Torek devised the operation to which his name is attached. For a number of years the operation was not widely used, but about six years ago Dr. Herbert Meyer reported on some sixty-five cases.

When one operates upon a case of undescended testis, in the majority of cases one is able, by carrying out the steps as outlined by Doctor Bevan, to elongate the cord sufficiently to be able to place it in the scrotum without undue tension. A small percentage of cases are found in which it becomes necessary to decide whether to divide the vessels in order to gain sufficient length or to abandon the operation. Dividing the vessels does definitely increase the likelihood of atrophy. There are plenty of examples in which atrophy did not take place if due care was taken not to injure the vessel that goes with the vas, but this division should be reserved for those cases where it is impossible to get length otherwise. Very rarely one finds a case in which, after the most careful dissection, the testis and the vas are too short to permit of sufficient elongation to place the testicle in the scrotum. In such a case it becomes a choice of doing a removal of the testis or replacing within the internal abdominal ring. In this very rare instance, if the case is a unilateral one, it is probably best to remove the organ. In most cases it is quite undeveloped. If the case be one of bi-lateral undescended testicle it is best not to remove it.

Some interesting work had been done by Moore on the temperature influence in the development of the spermatogenic function of the testicle. His experimental work on animals would lead to the assumption that one should make an effort to replace the testes in their physiological position in the scrotum before puberty. At what age it should be done is still a much debated question. His own judgment is that it should be done between the ages of eight and twelve, other factors being equal. If a troublesome hernia exists, it cannot be handled with a truss because of the associated undescended testis, and the operation should be done at an early period.

One point in the technic of the Torek operation worth emphasis is the hazard of placing the incision in the thigh in such a way that, when sutured to the scrotum, there is tension on the suture line. He had seen several of these cases where the separation of the suture line took place, which usually results in a slough of the testicle. The peculiarity of the scrotal skin seems to make a difference in the healing of the skin of the thigh. It does not heal with the same rapidity and firmness and in the same length of time.

There is one type of undescended testis in which operation should be advised only after the doubtful outcome is carefully explained to the parents, *viz.*, that form of dyspituitarism known as Fröhlich's syndrome. He had seen a number of these fat boys with bilateral ectopia, and he felt that the operation did not influence the general development and endocrine status of the child insofar as he had been able to determine.

Dr. F. N. G. Starr (Toronto, Canada) showed two lantern slides, and said that after the cord had been freed he took a silver wire as shown in the slide and sutured the tunica of the testicle to it. Then the testicle, after the scrotum had been stretched, was put down to the bottom of the scrotum. The two wires were brought out of a nick at the bottom, turning each transversely, two horsehair stitches caught it there and then a loop at the other end was sutured by a fine catgut to the periosteum in the os pubis. The results had been extraordinarily good.

Dr. J. Shelton Horsley (Richmond, Virginia) said that in two cases after separating the cord and mobilizing the testicle as much as possible, he placed a loop of non-absorbable suture, either silk or silkworm gut, in the bottom of the testicle, catching a firm hold. This was not tied but was brought through the bottom of the scrotum. The loop was then tied and fastened to a small rubber band, which was tied to a linen thread and the thread fixed by adhesive to the thigh, making traction on the testicle.

The procedure was such a simple thing that he was quite sure it was not original, although he had not looked up the literature. However, he thought it involved some rather common principles in plastic and other types of surgery in which gradual and gentle traction continued for a long period will often correct the position of misplaced structure. This suture on the testicle will hold a week or longer, depending upon how strong the traction is. The traction should be slight but constant. It will bring the testicle well down and then the suture can be removed without any trouble.

Dr. Frank S. Mathews (New York City) said it is remarkable how many body processes are initiated or modified by the hormones of the pituitary gland. Every one interested in the mechanism of cryptorchidism should be interested in the experiments by Doctor Engel, of New York, published in a recent Journal of Endocrinology. He worked upon Macaceus monkeys in which the testes at birth are in the upper end of the inguinal canal and which make their descent in the course of the next few years. By injections of anterior pituitary hormones he has been able to cause the testes to descend to the bottom of the scrotum within a month. It was an interesting observation that the scrotum elongates and descends conspicuously before the descent of the testis was observed. It is his belief that in the bilateral cryptorchidism in man the fault lies in the pituitary. When the condition is unilateral it is not unlikely that a mechanical cause is responsible.

Doctor Mathews had never done the Torek operation but has confined himself to the methods which depend upon freeing and elongation of the cord as much as possible. At the termination of the operation the result has often seemed satisfactory but when the patient is examined in a year or two there is disappointment. When sutures have been passed from the testis through the bottom of the scrotum and are then anchored to the thigh it has seemed as though the results should be improved, but the sutures soon cut out and, irrespective of the method used, can be depended upon only for about a week. He has wondered whether the results of the Torek operation were not due to the fact that the testis is removed from the upward pull of the scrotum during the time that it is attached to the thigh. When all the structures of the cord have been divided except the vas and vessels, it does not seem as if the cord could be responsible for the elevation of testis but rather a contraction of the scrotum.

Every one interested in this subject should read the work of Moore on the function of the scrotum, published several years ago. From his work it would seem unlikely that the transplantation of the testis into the scrotum after adolescence could possibly result in bringing about spermatogenesis in the organ. Conditions, however, are quite different when the operation concerns younger children.

Dr. Henry H. M. Lyle (New York City) said that four years ago in discussing Doctor Bevan's paper at Cleveland he called attention to the fact that the pull to which the testicle is subjected in the Torek operation seemed to have a stimulating effect on the opposite testicle. He cited a personal case of double undescended testicle in which during the first stage of the Torek operation the opposite testicle descended into the scrotum. Since then he had observed this phenomenon in two additional cases.

Regarding the applicability of this operation to the abdominal testicle one of his assistants has successfully transplanted such a testicle to the bottom of the scrotum in three stages. In the first stage the testicle was brought to the pubis, in the second to the thigh and finally, to the bottom of the scrotum. In this position the testicle has developed and appears to be a normal organ.

Dr. William B. Coley (New York City) said that of 80,736 cases of inguinal hernia in the male observed at the Hospital for Ruptured and Crippled, he found 1,357, or 1.65 per cent., associated with undescended or mal-descended testicle. From 1890 to 1918, 4,453 cases of inguinal hernia in the male had been operated upon, of which 334, or 7.5 per cent., were associated with undescended testicle. The majority of these

cases occurred in children under the age of fourteen, inasmuch as in the earlier days adult hernia patients were not admitted to the hospital.

As regards the undescended testis in adults, of 1,040 cases of hernia operated upon at the Memorial Hospital by Dr. William A. Downes and himself, forty-nine, or 4.71 per cent., were associated with undescended testis.

The method of operation adopted by Dr. William T. Bull and the speaker in 1892 and 1893 was, practically, the Bassini operation. They, however, omitted the step of transplanting the cord, thus adding a half-inch or more to the length of the cord. In addition, the cord was freed as high up as possible and the bands of fascia, which usually made it possible to place the testis in the bottom of the scrotum, were divided. At about the same time, and quite independent, Bevan developed his operation on the undescended testis, which embodied the principles just described and had several additional features which were improvements over their method. One of these was the purse-string suture of the tissues just outside the external ring which prevented the testis from retracting into the canal or above the external oblique. The second feature of Bevan's operation was the removal of a part or nearly all of the veins of the cord. This naturally added to the length of the cord and to the ability to place it at the bottom of the scrotum without much tension. Bevan himself restricted the excision of the veins to very difficult cases and did not use it as a routine operation.

In April, 1908, Doctor Coley reported 126 cases of undescended testis personally operated upon and traced as far as possible to end-results. Ten years later before the Southern Surgical Association (Surg., Gynec., and Obstet., May, 1919) he reported 365 cases of undescended testis operated upon at the Hospital for Ruptured and Crippled to which were added fifty cases in adults operated upon by Doctor Downes and himself at other hospitals, making a total of 415 cases; seventy-seven were of the inguino-superficial variety and eight of the inguino-perineal type; 149 cases were traced from one to twenty years.

While their results were, in their opinion, reasonably satisfactory, they were not absolutely ideal, since in a considerable number of cases the testis retracted to the region of the external ring. There was no case of death or of recurrence of the hernia in the entire series. When Keating of England brought out his operation for undescended testis, the principal step of which consisted in burying the testis for a short period in the thigh at a level with the scrotum, Doctor Coley was not at all impressed with it. A few years later Torek brought out his operation. While this seemed markedly superior to Keating's, Doctor Coley was still unconvinced that it was sufficiently superior to Bevan's method or to the one employed at the Hospital for Ruptured and Crippled to warrant it substitution. It was not until 1927 when Dr. Herbert Willy Meyer read a paper at the New York Surgical Society on the Torek method and presented a large series of end-results which were more satisfactory than any Doctor Coley had observed from the older methods, that he was finally convinced of the superiority of the Torek operation. Soon after, Doctor Burdick and Dr. Bradley L. Coley began performing the Torek operation at the Hospital for Ruptured and Crippled, with the results which have just been presented.

In attempting to review the whole question in a judicial way it seemed to him that it might be better to admit that the results obtained by the Torek operation are more satisfactory than those obtained by the older methods. At the same time he would reserve the Torek operation for the group of more difficult cases in which it is almost impossible to place the testis in the bottom of the scrotum without great tension, and would continue to treat the larger group of less difficult cases by the Bevan operation which has proved so highly satisfactory in the majority of cases.

Regarding the proper age for operating on the undescended testis, there is still considerable difference of opinion. Many years ago he adopted the plan of waiting until the patient had reached the age of ten or twelve years before operating unless there was some special reason for an earlier operation, in the way of a hernia which was not

easily controlled. He still follows this plan although some advise operating as young as from five to six years. His principal objection to an earlier operation is based on the fact that in a considerable number of cases the testis has descended of its own accord as the child approached puberty.

Some surgeons advocate the removal of the undescended testis on the ground that it is of no special value. While most writers regard it of no functional value, there is no question but that the interstitial elements of the testis have an important bearing on the development of the male characteristics of the child, and for that reason he believes the testis should not be sacrificed. It is by no means true that the undescended testis is always functionless. He had two patients with double undescended testes who married and had children.

Dr. Carl Eggers (New York City) said that as a pupil of Doctor Torek he early started in to use the method which he has described. In his hospital service it is used to the exclusion of others in all patients admitted for the purpose of having the position of the undescended testicle corrected. Some patients come in for the repair of an associated hernia rather than for the undescended testicle. At times one has to make a distinction between the two, especially in adults, because some are more interested in having the hernia repaired than they are in the position of the testicles, and they do not wish to have two operations performed.

With children, particularly, it is a question of both. The mother of the child is not interested in the hernia alone. She wants her boy to be a normal boy. When one follows results of other methods and sees that after awhile the testicle has shrunken or has retracted to a position where it produces pain and discomfort and is unsightly then it becomes apparent that a method which will give a normal-appearing scrotum and testicles and at the same time relieve the hernia is the one to be adopted.

Other methods of traction have the disadvantage that they leave a canal at the bottom of the scrotum through which infection may enter. In children that is an important point. Doctor Torek's method is a closed method. It is strictly surgical. The one point is that it is a delicate operation. Particularly in children great care has to be used in handling the organ. One must not be rough. But if these points are observed the results are excellent.

Personally, he had done the operation thirty times and all of them show a very satisfactory result. There is a well-developed pendulous scrotum and the testicle is situated at the lower part of that scrotum.

In patients with bilateral undescended testes he always does the operation in two stages for several reasons. It has to be done carefully and takes time, frequently as long as one and a half hours. There must be no undue tension on either scrotum or testicle and this is best accomplished by doing one side at a time. The organs have a better chance to accommodate. At the first session one testicle is brought down; the next operation is done about six months later, when the first side is separated and the other side brought down. The third operation consists of simply separating the second side. There is no definite period which should be allowed between operations. He had found six months to be sufficient time to allow the organs to accommodate themselves to their new position. There has never been retraction of a testicle. One may wait longer, if one so desires.

Dr. John H. Gibbon (Philadelphia) emphasized two points which he considered of prime importance irrespective of the type of operation done. First was the necessity of freeing the component parts of the cord from surrounding tissues and from one another; this is the only way the testicle can be brought down without tension. The mere cross-section of the sac and the high removal of the proximal portion is but the first step in the mobilization.

The second point was the preservation of the blood-vessels, even the veins, because in applying ligatures the tiny but essential arteries may be included. On this point

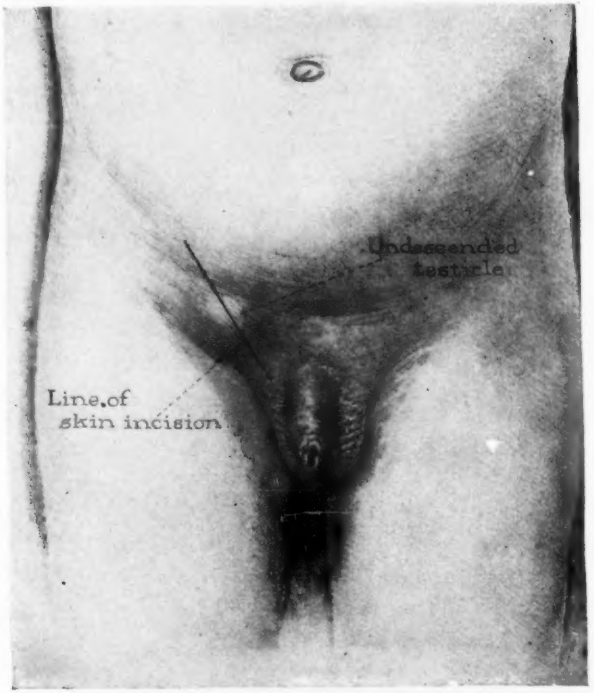


FIG. 9 shows the incision through the skin and superficial fascia made in the same line as the incision for inguinal hernia. Notice that the incision is carried downward just to the scrotal tissue but not beyond.

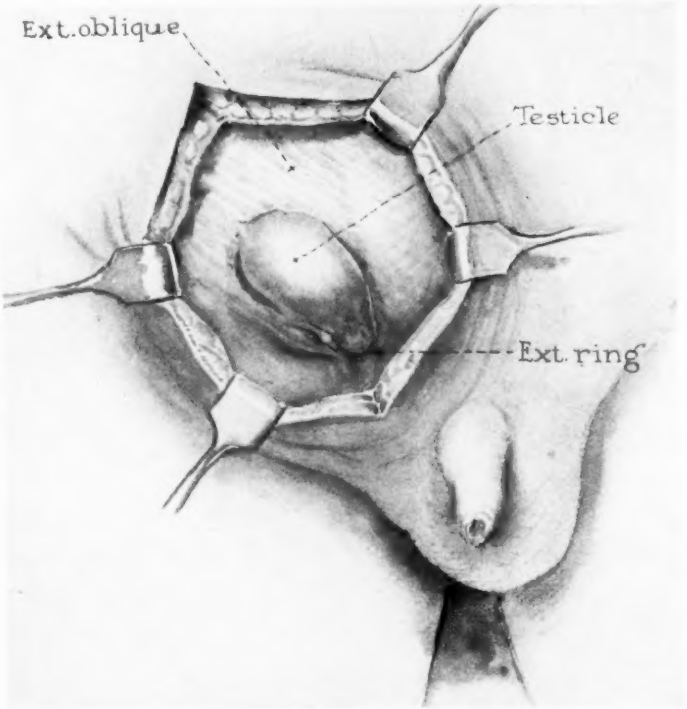


FIG. 10 shows the position of the testicle outside of the inguinal canal and lying over the inguinal canal. This is the position found in the majority of cases.

hang the future position and development of the testicle. Doctor Bevan long ago gave up the division of the veins of the cord which he had originally recommended in certain difficult cases.

Dr. Arthur Dean Bevan (Chicago) remarked that the purpose of operations for undescended testicle is to do in the period which is required to perform the operation, say an hour, what nature does slowly and gradually in the normal descent of the testis in a period of weeks and months. A great many men who have undertaken these operations have not had a complete conception of the anatomy or of the technic that is required to do the operation successfully. It is absolutely essential that the operator should know that in freeing the testis it is necessary to remove completely from the

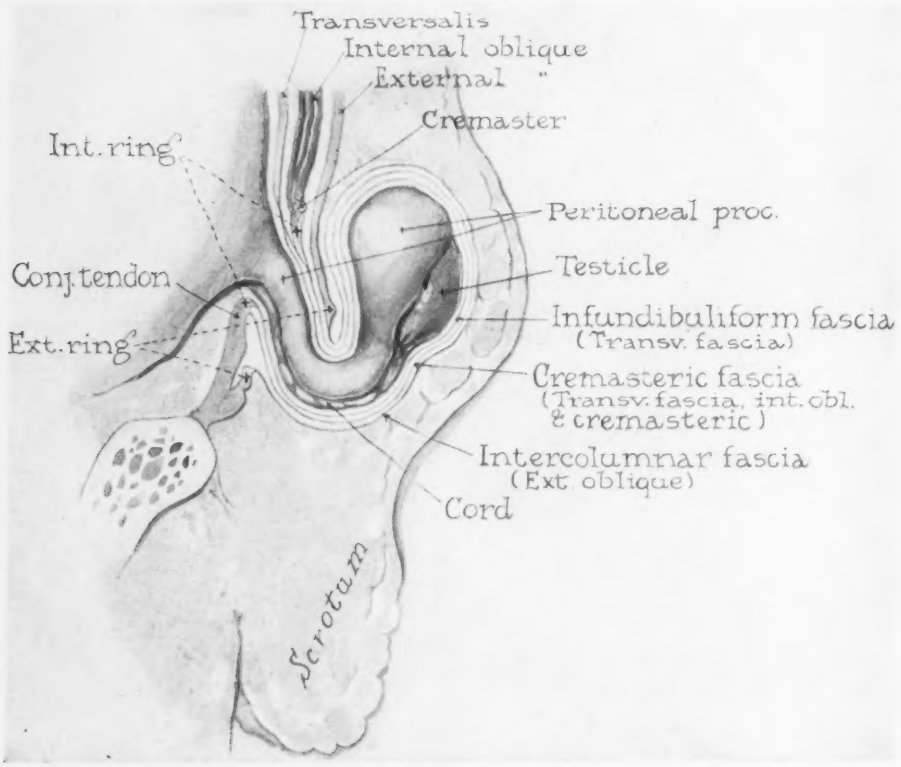


Fig. 11 shows a cross-section of this anatomical area and shows the position of the testicle, and in addition to the skin and superficial fascia shows clearly the three layers of fascia, the intercolumnar, the cremasteric muscle and the infundibuliform fascia surrounding the cord and the testicle. It also shows the vaginal process of peritoneum.

cord the following structures which surround the testicle and the cord: the intercolumnar fascia, the cremasteric muscle fascia and the infundibuliform fascia, as well as to strip the cord completely of the vaginal process of peritoneum. The steps of the operation can be best shown by the illustrations which were drawn by an artist from an operation. (Figs. 9, 10, 11, 12, 13, 14, 15, 16 and 17.)

He had done a large series of these operations. He could not see any fair indication for complicating the operation of undescended testis with any scheme of suturing the testicle to the thigh or of holding the testicle down with traction sutures of any kind during the process of repair. Before undertaking work of this kind the surgeon should know that there is a certain proportion of cases, possibly 10 per cent., in which the organs are so illy developed (often the testicle is a mere rudimentary bud) in which

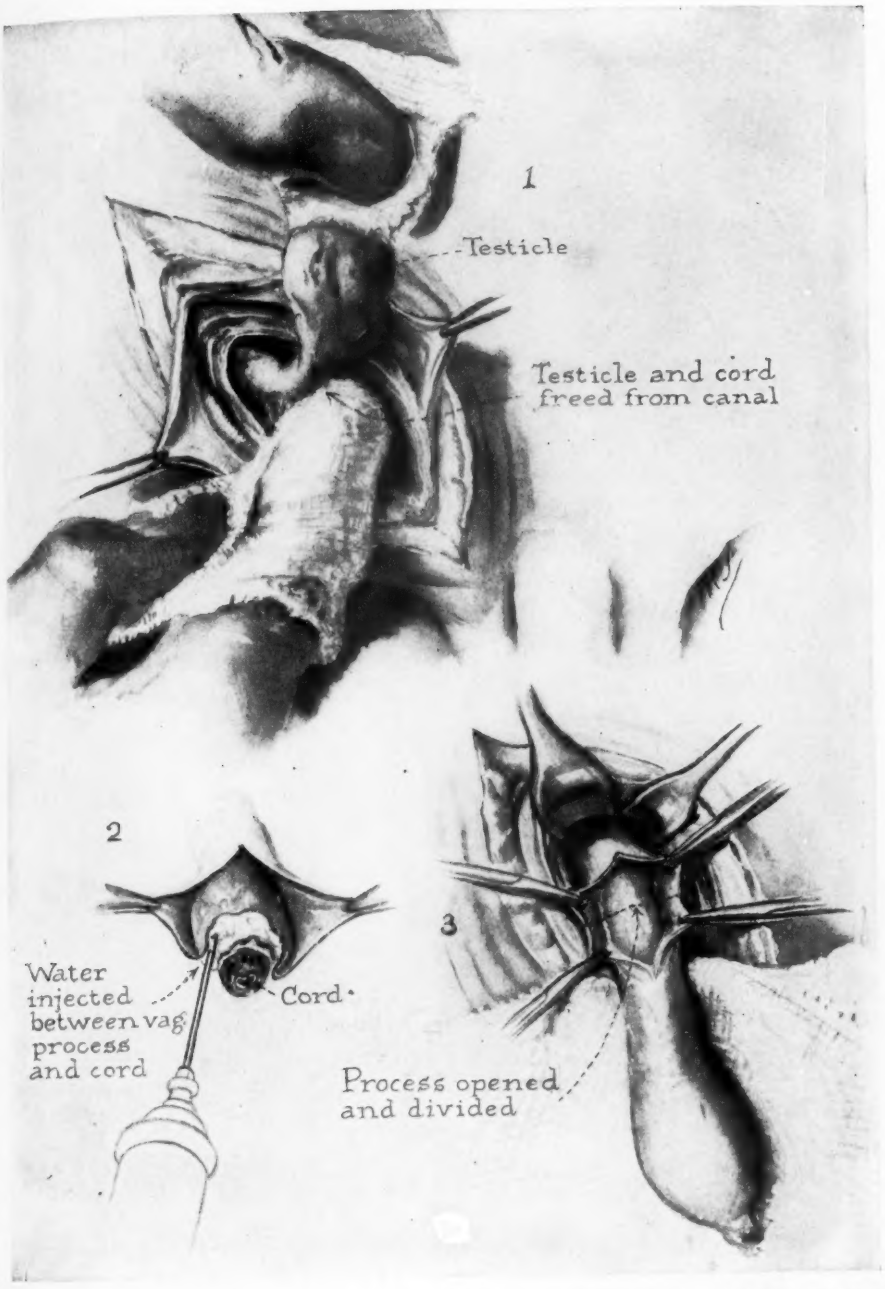


FIG. 12 shows the testicle and cord lifted out of the canal after the external oblique has been divided up to the internal ring and below this it shows the injection of normal salt solution beneath the vaginal process of peritoneum in order to lift it off from the cord and make the transverse division of the vaginal process easier.

the structures of the cord are so short or in which the testicle is still well up in the abdominal cavity, that it is impossible to bring the testicle down and place it in its normal position by any method of operation. Some of these rudimentary testicles are

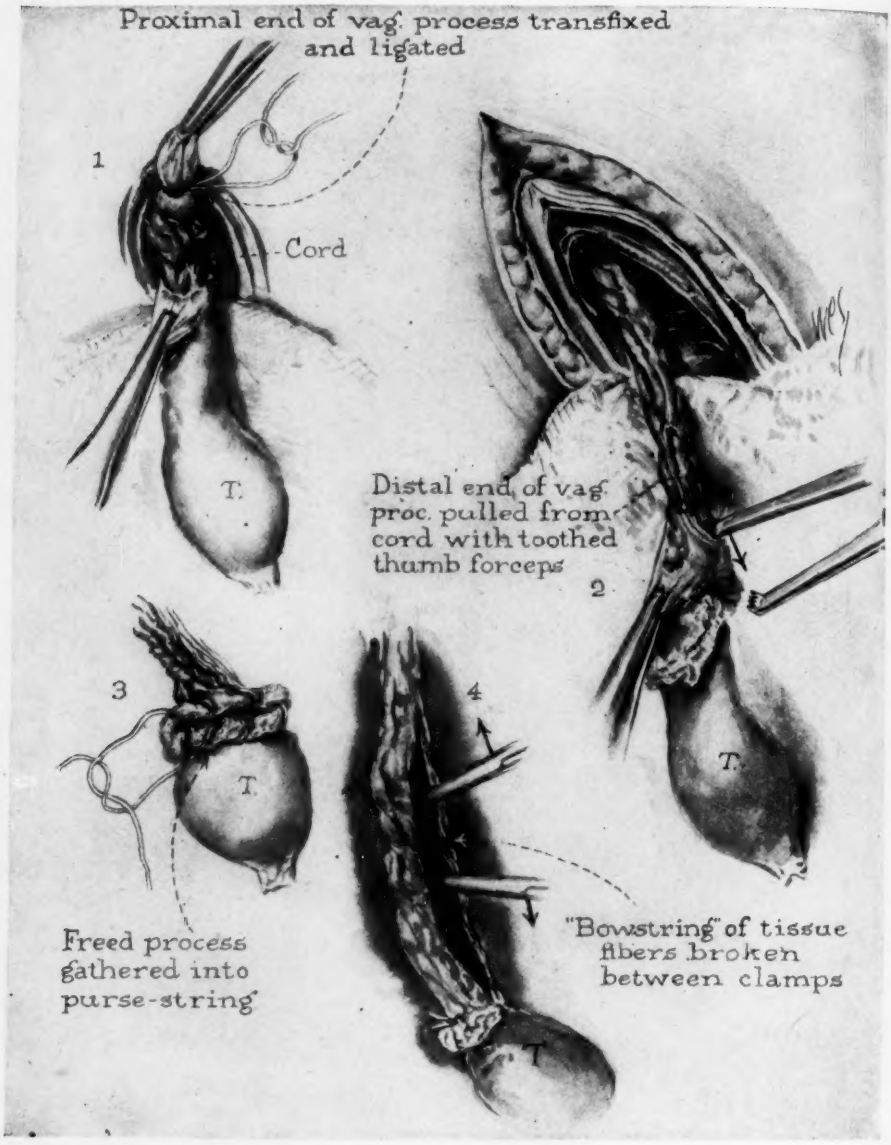


FIG. 13 shows the complete stripping off from the cord of the intercolumnar fascia, the cremasteric muscle fascia and the infundibuliform fascia from the internal ring down to the testis and the closure of the upper end of the vaginal process; transfixion and ligation as we do in closing an inguinal hernial sac; also the forming of a tunica vaginalis by closing with suture the lower end of the vaginal process of peritoneum just above the testicle. It further shows the tearing across of some strands of connective tissue from the cord in order to secure complete lengthening.

best removed. Occasionally where the cord is very short and the testicle otherwise fairly normal it may become necessary to divide the spermatic vessels in order to lengthen the cord sufficiently to place the testicle in its normal position in the scrotum.

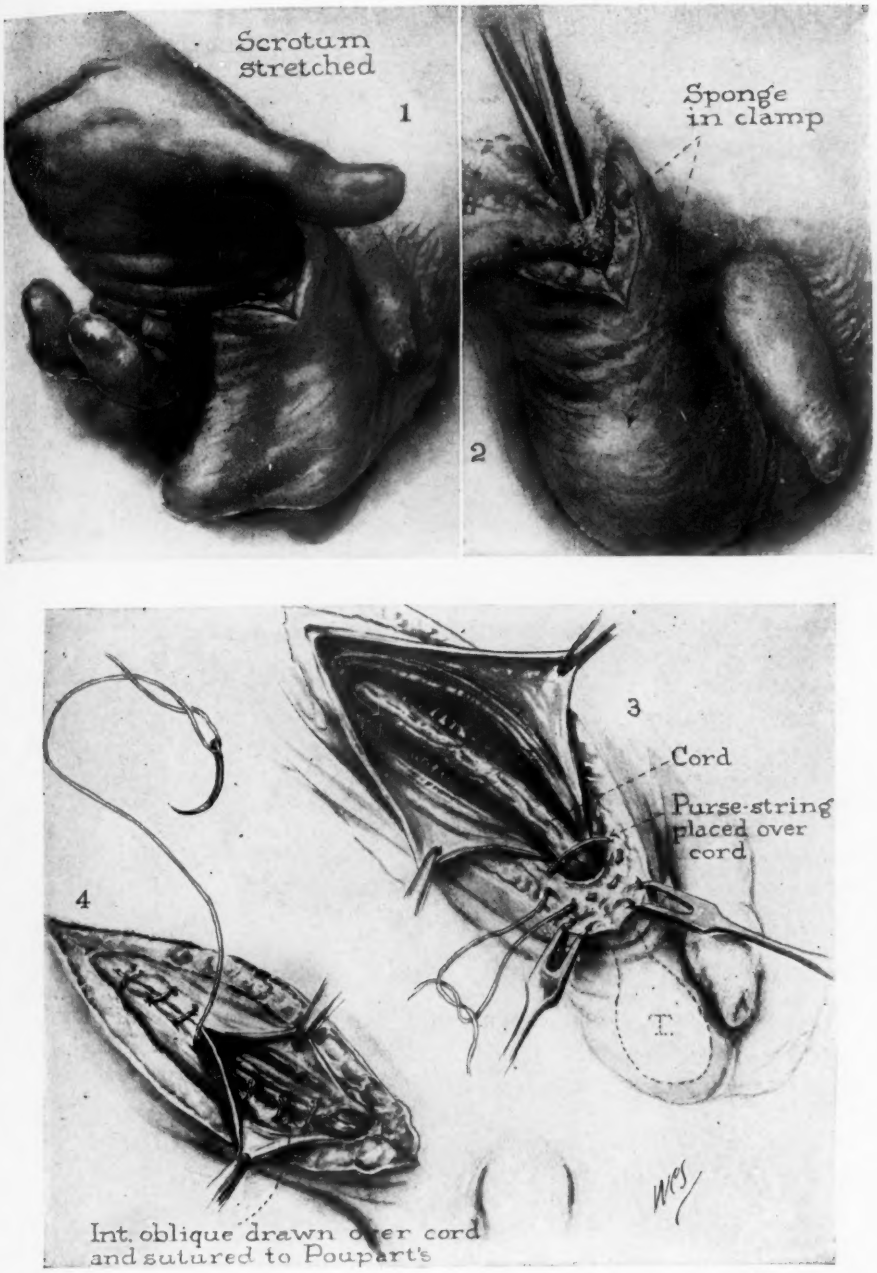


FIG. 14 shows the making of a pocket in the scrotum, first with the fingers and then by packing the scrotum very fully with a gauze sponge. The lower part of this plate shows the introduction of a purse-string suture at the neck of the scrotum, this suture, of course, being placed in front of the cord and in such a way so as not to compromise the cord in any way. It also shows the closure of the structure over the canal, the bringing of the conjoined tendon to the shelf of Poupart's and the closure of the external oblique to the edge of Poupart's.

FIG. 15.

FIG. 16.

FIG. 15 shows a step in the operation which simplifies the placing of the testicle into the scrotum and retaining it there while the operation is being completed, that is the placing of the purse-string suture at the neck of the scrotum. You will see in this plate that we have put a fine catgut stitch through the fibrous covering at the lower end of the testicle. We then threaded this stitch double through the eye of a straight needle and carried the straight needle down to the lower part of the scrotum after the pocket has been made.

FIG. 16 shows an assistant holding the testicle well down in the scrotum during the introduction of the purse-string suture at the neck of the scrotum and the closure of the canal; when the operation is completed one strand of this catgut is divided and the entire catgut pulled out. This is easily done as we do not tie the catgut into the lower end of the scrotum.

He very seldom divided the vessels, and yet undoubtedly in a limited number of cases it is better to do this than it is to drop the testicle back into the abdominal cavity or to remove it because in a fair proportion of the cases operated on in early life, even though the vessels are divided, the blood supply is sufficient to carry on the nutrition of the organ.

If these testicles are operated on at the age of five or six years, which is probably the most favorable age, they can be very easily done then; most of them can be brought well down. The time to operate on these cases is very early, long before puberty. It does not do any good at all to operate after puberty except for the psychic effect and for the cure of an associated hernia.

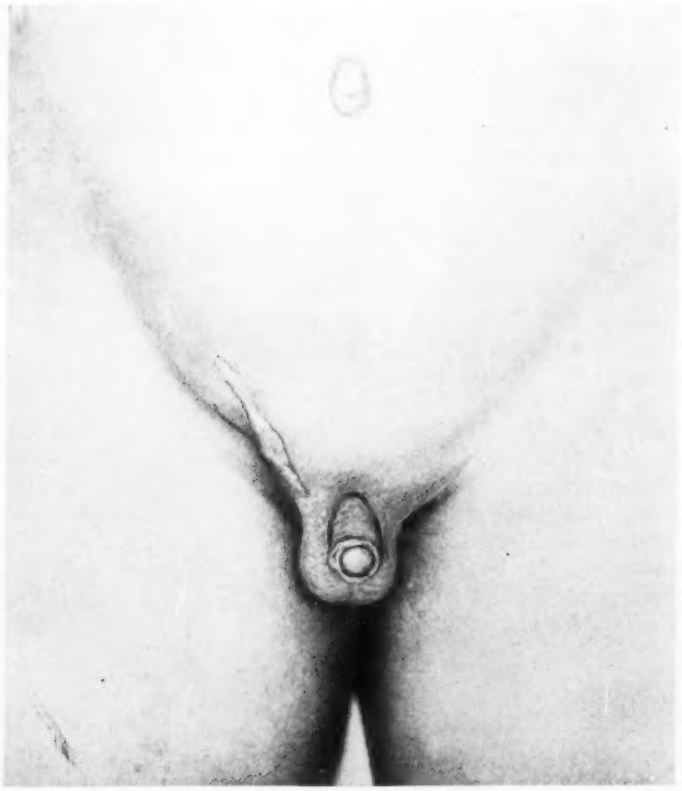

FIG. 17 shows the usual result obtained in a case of this kind. This is in a boy of about ten years of age.

DR. FRANZ TOREK (New York City) said that it was quite natural that every surgeon would select the technic that appealed to him and that he was most accustomed to employing. Ordinarily, before an association such as this one, minor points in technic seem insignificant, but as some of them have been brought up he should like to say something about them.

One point was the attachment of the scrotum to the thigh by a subcuticular continuous suture. He has always used the interrupted suture through skin and subcutaneous tissue, and he tries to get a broad apposition of raw tissue, which is done by taking very little skin and a good deal of raw tissue, in adapting the parts. He has felt that in this operation, just the same as in other surgery, especially in plastic surgery, the important thing is to get a very accurate apposition which leads to the promptest and most certain healing. Consequently, he has adhered to the suture through the skin

and subcutaneous tissue, and has had no reason for deviating from this method of suture because in his cases the scrotum has always remained attached, and, as he sees, with the other method there have been two cases where it loosened.

Another point, which is not simply a technical one but one of more fundamental importance, is the attachment of the testicle to the fascia of the thigh, not by interposition of any other structure but a direct attachment. The reason why he considers this to be of fundamental importance is because they have to deal, at least in their bad cases, with a rudimentary testicle or at least a very poorly developed one. These badly developed testicles usually have very small and short vessels so that probably they are not well nourished from their own vessels and the attachment of the thigh gives the testicle a new supply of blood. It is possibly the addition of this supply from a new source which has something to do with the fact that in all their cases the testicles have increased in size.

He called attention to a publication that appeared last year by Wangenstein, of Minneapolis, who practices the operation in the same way as Doctor Torek does, with one exception: namely, in the attachment of the testicle to the thigh he leaves the tunica vaginalis communis intact, incising the scrotum only down to this tunic but not through it. Then he passes his sutures through the testicle and through the tunica vaginalis communis before anchoring them to the thigh.

Doctor Torek believes this to be a mistake, as it fails to give the testicle nutrition from a new source.

The matter of bringing both sides down at the same time has been mentioned. He certainly admits that there may be some cases in which it is possible. Where, however, they have to deal with an absolutely rudimentary scrotum he does not think it would occur to anybody to try it because they simply have not enough skin to go across from one side to the other.

There is one thing that has impressed him very forcibly and that is the question of the action of the pituitary. He hopes that will be investigated further. If it proves successful, if the action of the pituitary should establish sufficient development of scrotum and testicle, the operation he has described would no longer be needed. The assumption that an endocrine element has something to do with the descent and development of the testis seems to be supported by Doctor Lyle's observation that after he had brought down one testicle and it had developed properly, the other testicle descended without operation. All of these things have to be studied.

# OMBRÉDANNE'S POUCH OPERATION FOR HYPOSPADIAS

By Henry H. M. Lyle, M.D.
of New York, N. Y.

The object of this paper is to call attention to the satisfactory and constant results obtained in Ombrédanne's pouch operation. We feel that the merits of this operation should be better known in this country. The surgical text-books do not mention it, the urologists apparently ignore it.

The uncertain and discouraging results obtained after a conscientious trial of the standard operations for hypospadias decided us to abandon operative therapy when we had the good fortune, while in Paris, to observe Ombrédanne's pouch operation.

The Ombrédanne operation introduces an entirely new principle in the plastic repair of the urethra. The fundamental advantages are that the pouch urethra delivers the urine to the meatus without the possibility of leakage; and that there are no lateral edges to separate. It does away with the necessity of diverting the urine by an indwelling catheter, an external urethrotomy or a suprapubic cystotomy.

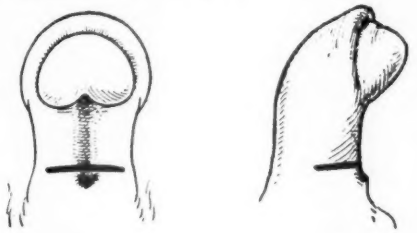

Fig. 1.—Transverse incision for lengthening the organ.

*Preliminary Preparation for Operation—Straightening the Penis.*—(Fig. 1.) The majority of hypospadiacs have an associated incurving deformity of the penis. This deformity must be corrected and sufficient time allowed to elapse before the Ombrédanne operation can be undertaken. The deformity is not caused by the shortening of the skin but by the presence of fibrous bands and aplastic tissue; these pathological tissues prevent the corpora cavernosa from assuming their proper length. These bands and tissues are excised and the corpora cavernosa freely exposed. As a result of this the hypospadiac meatus recedes posteriorly and the transverse incision becomes an oblong gap. The opposing edges are then sutured and the penis fixed in hyperextension. (Fig. 2.)

*After-care.*—The sutures are removed on the twelfth day but hyperextension is maintained until the tissues become pliable. This time varies from two to four months.

Ombrédanne's pouch operation is performed in two stages: The first stage

is an autoplastic procedure which gathers under the glans a mass of tissue, designated by Ombrédanne as the "tubercle." Its length equals the glans but it is separated from the part by two lateral furrows. In the second stage the "tubercle" is united to the glans.

*First Stage.*—A detailed description of the operative technic employed in penile hypospadias will be given, and comment on the modifications required in the glandular and perineal types made.

(1) *Technic of an Operation for Penile Hypospadias.*—The placing of the purse-string stitch. (Fig. 3*a*.) A linen suture outlines the periphery of the sac. The length of the distal portion of the flap corresponds to the distance from the hypospadiac meatus to the extremity of the glans, the proximal half of the flap being equal to that of the distal. At the level of the glandular furrow (Fig. 3*b*) the needle is passed under the mucosa and the mucosa lifted in order to avoid the larger veins. The stitch is continued under the mucosa of the glans to its tip and then carried down on

FIG. 2*a*.

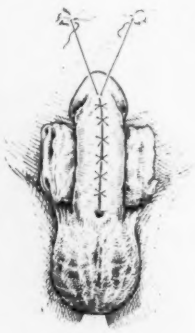

FIG. 2*b*.

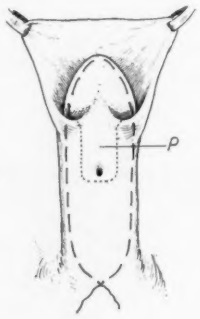


FIG. 3*a*.

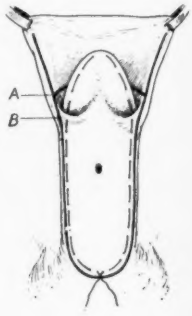


FIG. 3*b*.

FIG. 2.—(*a*) Freeing of corpora cavernosa, the transverse incision is now an oblong gap. The hypospadiac meatus has receded posteriorly. (*b*) Fixation of the penis in hyperextension during healing of tissues.

FIG. 3.—(*a*) Placing of the puckering stitch. The flap *P* is left adherent. (*b*) Outlining the lateral and preputial flaps.

the opposite side to a point where it was originally inserted. The breadth of the flap is equal to one-third the circumference of the penis.

(2) *Dissection and Liberation of the Flap.*—(Fig. 4*a*.) The proximal half of the flap should be carefully dissected up to the level of the hypospadiac meatus. When the dissection approaches the meatus a catheter is inserted and great care taken to avoid damaging the skin and mucous membrane as they are often reduced to a paper-like thinness. A misstep here may ruin the final result. The portion of the proximal flap extending from the hypospadial meatus to the glans, and equal to the breadth of one-fourth of the circumference of the penis, is left adherent (Fig. 3*a*). It is this base that furnishes the blood supply for the future urethral sac. The outlining incision is made 1.5 millimetres external to the puckering suture. The incision bifurcates at A, the vertical limb passes upward to the angle of the stretched prepuce, and the horizontal limb encircles the mucosal surface of the prepuce parallel and two millimetres from the furrow of the glans to meet the vertical incision on the opposite side. The external edges of the horizontal incisions, and the mucosal flap on the prepuce are carefully freed. The sac is now puckered by tightening the purse-string suture, care being taken to allow enough room for the passage of the urine.

(3) *Making the Y-shaped Incision.*—(Fig. 4*b*.) A Y-shaped buttonhole is cut in the preputial flap. The vertical arm of the Y begins at the level of the collar of

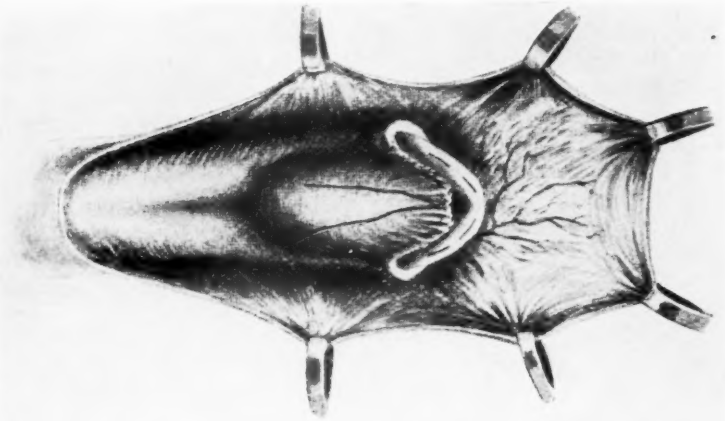

FIG. 4a.—All flaps are freed and the sac closed by a purse-string suture.

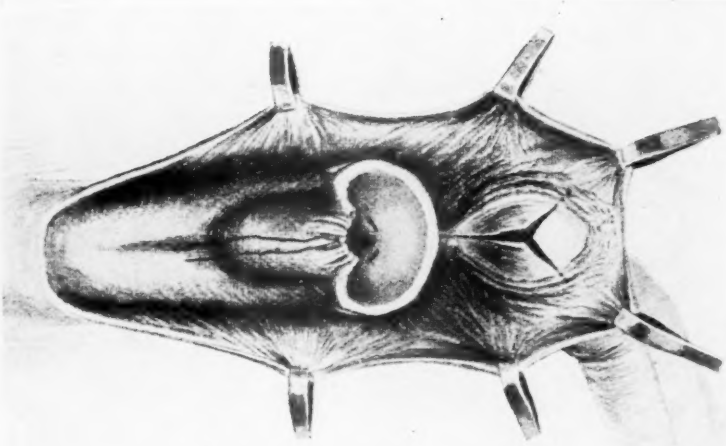

FIG. 4b.—Making the Y incision in the preputial flap so that its nutrition is not compromised.

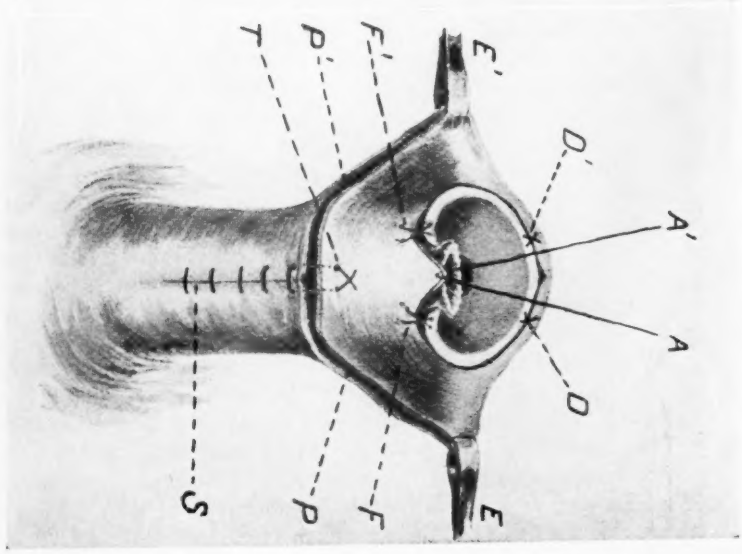


FIG. 5.—The glans is passed through the Y-shaped incision and the flap sutured.

the glans and is placed in an avascular area between two longitudinal veins. The tip of the left index finger is placed on the cutaneous side of the preputial flap and the vertical incision deepened to the skin. The overlying soft parts having been pushed aside by blunt dissection, the Y-shaped incision is made in the skin. The displacement of the subcutaneous tissue and vessels is an important detail in the conservation of the nutrition of the preputial flap.

(4) *The Passing of the Glans through the Y-shaped Incision and the Fixation of the Flap.*—(Fig. 5.) The preputial flap is put over the glans just as the clergyman puts a stole or chasuble over the head. The glans emerges on the cutaneous surface of the preputial flap while the raw surface of the flap is spread over the inferior surface of the penis. The long ends of the purse-string suture *A.A.'* are passed through the triangular opening and tied.

(2) The triangle, made by the divergent arms of the Y, are sutured on each side of the opening of the sac *F.F.'*

(3) The shoulders *E.E.'* are grasped with an Allis clamp and pulled out to prevent the formation of fistulæ.

(4) Two sutures are inserted at *D.D.'*

(5) The edges of the preputial flap *P.P.'* are united.

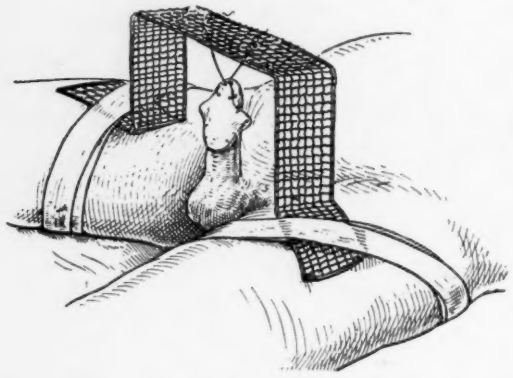

FIG. 6.—The suspension of the penis to allow the flaps to unite without folds.

(6) The preputial flap will not cover all the bed from which the sac was taken; but the remaining raw surface is readily covered by uniting the lateral edges of the original incision along the line *S*. The junction of preputial flap to the line *S* is secured by a mattress suture *T*. (Fig. 5.)

*The Immobilization and Dressing.*—(Fig. 6.) The penis should be gently stretched for four or five days so that the preputial flap becomes fixed without the formation of folds. This position, if maintained correctly, diminishes the accompanying œdema. No dressings are required—simply wash the parts after urination and dust with a bland antiseptic powder.

*Complications.*—If the sac has been made too long, a small point of this flap may slough. This is of little importance because the preputial flap practically never sloughs but becomes adherent to the rest of the sac and assures a channel for the urine until the second stage of the operation is undertaken.

*Post-operative Œdema.*—Post-operative œdema can be reduced to the minimum by gentleness, the avoidance of interference with the nutrition of the flaps as outlined above and by careful post-operative care. The dependent position is to be avoided and all traction to be of the gentlest nature. If the œdema becomes excessive, puncture the œdematous mucosa with a needle and apply a mild solution of adrenalin.

*Perineal and Vulvoperineal Hypospadias.*—(Fig. 7.) The first stage of the repair of this deformity consists in turning the perineal orifice into a penile orifice. In order to do this the cutaneous posterior flap may have to be carried back almost to the anus. At the root of the penis it is necessary to make a second small lateral incision to permit the forming of two scrotal flaps to cover the mass of the sac at its new orifice. The perineal meatus is now converted into a penile meatus and when this newly formed penile orifice is well established we proceed as described above. Ombrédanne states that in some of the very difficult cases he has made three successive sacs.

*Glandular Hypospadias.*—In those cases requiring operation the same technic is used as in the penile hypospadias. As the prepuce is ample the raw surface and small sac are readily covered.

*The Second Stage.*—A period of approximately four months is allowed to pass

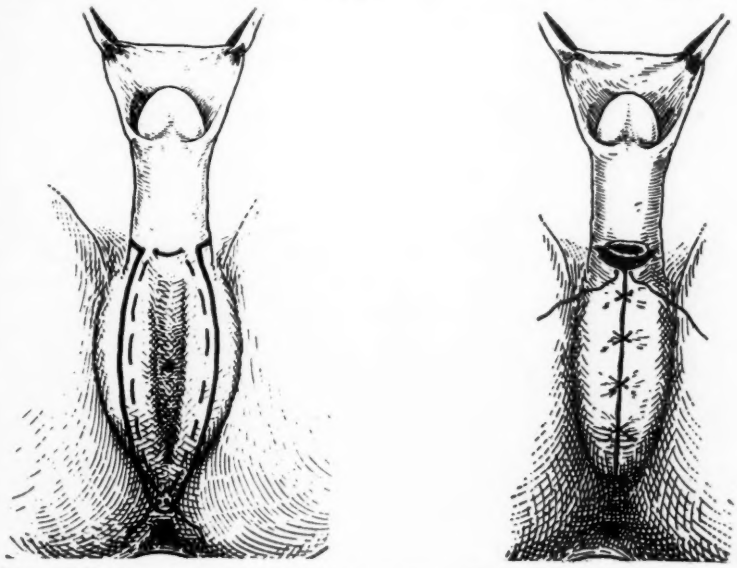

FIG. 7.—Method of treating a perineal meatus. The sac is advanced in two stages. The perineal meatus becomes a penile meatus.

before the second stage is undertaken. This stage consists of the union of the "tubercle" to the glans.

*Refreshening the Edges.*—The mucosa at the summit of the glans is grasped with an

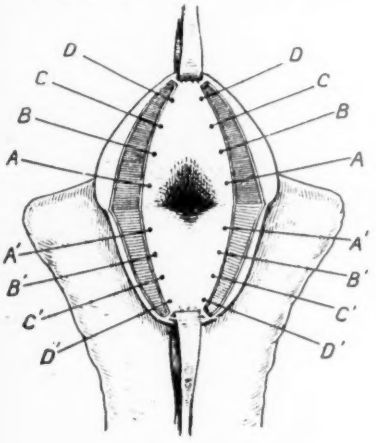


FIG. 8*a*.

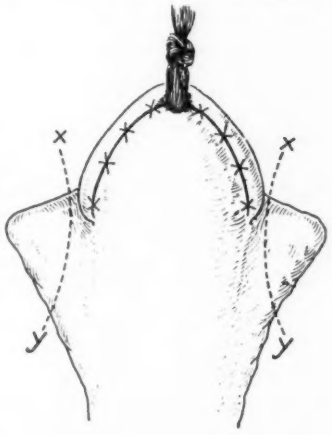


FIG. 8*b*.

FIG. 8.—(*a*) Union of the "tubercle" with the glans, the internal layer of sutures. (*b*) Union of the "tubercle" with the glans. The long ends of the internal sutures have been brought out through the meatus and knotted. The external sutures have been placed and tied. X, Y, direction of the lines for excision of the ears.

Allis clamp and a second one is placed on the summit of the "tubercle." Retraction is made in opposite directions and the reconstructed canal will open like the bill of a whip-poor-will, exposing all the details of the interior. The cutaneous portion of the lining may already

show a growth of hair. With a fine curved scissors the hair with a complete thickness of skin is excised. Retraction should not be feared. If desired or necessary the whole cutaneous area of the inferior surface can be safely excised as there is sufficient mucosa on the roof of the canal to furnish a complete covering. This will prevent the possibility of hairs projecting from the meatus. The breadth of tissue grasped by the clamps indicates the size of the meatus. A broad strip of tissue three to four millimetres in thickness, extending between the clamps, is excised. Internally a strip of mucosa five to six millimetres broad is reserved; externally as much as is needed can be removed. In preparing the raw surfaces of the glans the mucosa alone is excised, bleeding is thus prevented and an excellent surface for union provided. (Fig. 8*a*.)

*The Sutures.*—In young children one layer of sutures suffices; while in the adults and older children a double layer is required. The internal layer of sutures consists of fine chromic gut passed through the edge of the mucosa, they are tied and the long ends of the sutures brought out through the meatus and knotted. The external layer of non-absorbable sutures is inserted and tied as in the repair of the cervix, the suture including three-fourths of the denuded surface. (Fig. 8*b*.)

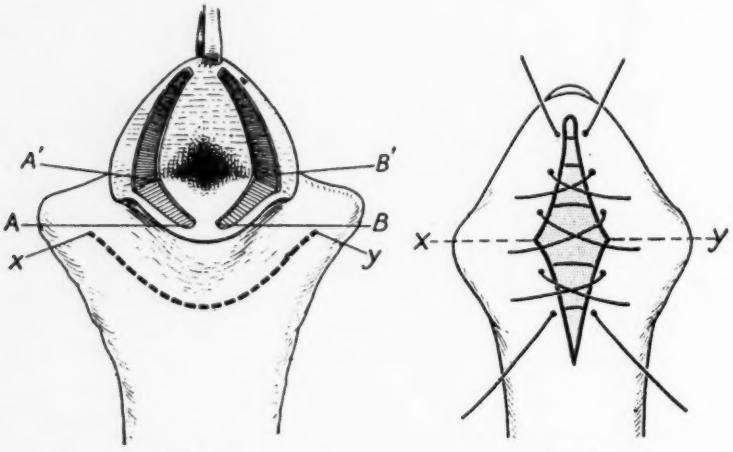


FIG. 9*a*. FIG. 9*b*.

FIG 9.—(*a*) Method of union if "tubercle" is short. X Y is a concave transverse incision. (*b*) Transverse incision is converted into a longitudinal incision to lengthen the "tubercle."

*Æsthetic Touching up.*—(Fig. 8*b*.) Excise the ears (X, Y) and any other cutaneous tags. In doing so avoid cutting into or placing sutures in a possible lateral extension of the pouch.

*Exceptional Cases.*—Occasionally there is no rounded "tubercle," the cause being a partial sloughing, or an excessive retraction of the sac. The method of meeting the condition is illustrated in Fig. 9*ab*.

Ombrédanne's operation provides a functional organ that differs from the natural penis in two insignificant details. The meatus is triangular in shape and there is a small piece of brownish preputial skin on the inferior surface of the glans.

*Indications and Contradications.*—Mild glandular cases with a straight penis do not require an operation. There is doubt about the advisability of operating on the advanced cases associated with hermaphroditism where it is difficult to determine the sex. It is indicated in all other cases and also in mild glandular types, where the knowledge of the deformity is causing a loss

of morale. The most favorable time for operation is between the ages of six and eight years.

Ombrédanne reports 250 cases without a failure. We have operated on nine cases; five of these cases are completed and cured, four are awaiting completion. The first operation was completed more than three and one-half years ago; one of the completed cases has had a Torek's operation for a single undescended testicle. One of the cases in the process of completion has had a single Torek operation for undescended testicle and another has had a double Torek operation. Thus in a series of nine cases we have had three patients with undescended testicle. The effect of the operation on the morale of a backward country boy is evidenced by a letter we received last Christmas. This nine-year-old boy had been operated on one and one-half years ago for a penio-scrotal hypospadias. *"Dear Dr. Many thanks for what you have done for me, I am the honor boy in fourth class. I can lick anybody in the school and can P as far as any of them. Merry Christmas from me and Mother."*

*Summary.*—(1) The Ombrédanne pouch operation for hypospadias yields constant and satisfactory results.

(2) The operation is based on a new plastic principle which overcomes the possibility of lateral leakage.

(3) It yields a normal functioning organ uninfluenced by erection.

(4) The keynote to success is gentleness, thoroughness and personal attention to the details of the post-operative care.

In conclusion we wish to acknowledge our indebtedness to Professor Ombrédanne. We have drawn freely from Ombrédanne's Précis Clinique et Opératoire de Chirurgie Infantile.

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# PRINCIPLES *versus* DETAILS IN THE TREATMENT OF ACUTE EMPYEMA

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If any apology is needed for bringing this hackneyed subject to the attention of this Association again our reason for it is that we feel that the whole question has been much confused by over-emphasis on details of treatment with a corresponding lack of emphasis on the underlying principles. The confusion has become so great in the minds of many that the opinion has arisen that patients with acute empyema are being badly treated unless the particular details recommended by some one or a particular gadget or apparatus recommended by some one else is used. In a general way, the confusing situation has been created by recent enthusiastic advocates of aspiration as a sole method of treatment and by others who have created a feeling that some form of continuous closed drainage is essential or at least desirable. To accomplish continuous closed drainage many instruments and at least one complicated apparatus have been invented.

We hope to be able to show that the concentration of attention upon various details in the treatment of empyema has not accomplished any more good than can be obtained by the application of the general principles which are now well known and that the over-emphasis which has been placed on details by some writers has perhaps been a source of harm.

It is fully recognized that the first object in the treatment of empyema is to save the life of the patient, but there is also a second object, which is to shorten the period of convalescence as much as possible. The experiments which were carried out during the World War by R. D. Bell[1] and one of us[2] showed apparently conclusively that patients with pneumonia or with a beginning empyema were very likely to be killed by the injudicious use of an open drainage. The principal reason for the deaths of such patients was the altered pressure relationships induced by an open pneumothorax. In any individual whose mediastinum is not stabilized, either by induration of the mediastinal pleura, or by the presence of adhesions between the lung and the chest-wall, an alteration of pressure on one side of the chest is reflected to the other side to almost the same degree. The significance of this observation is that both lungs become seriously handicapped and that if the vital capacity is very low, as it is likely to be in any case of pneumonia, the additional embarrassment to respiration produced by the open pneumothorax is sufficient to cause death from asphyxia in many cases. As a matter of fact, the average mortality during the World War, until this principle was recognized, was close to 50 per cent.

The general acceptance of this principle led to the use of various expedients to secure drainage of the pleural cavity without creating an open pneumo-

thorax. It is an interesting fact that empirically it has been noted from time to time that in patients with empyema, either in a developmental stage or after it was well established, there was in general a lower mortality rate after some form of closed drainage than after an open drainage. It is significant that as early as 1844 Hamilton Roe,[3] before the London Medical Society, reported nine cases of empyema with eight recoveries treated solely by the use of an aspirating syringe. From time to time in the literature there appears an enthusiastic account of the efficacy of aspiration as a sole method in the treatment of this condition. The most recent version has been aspiration with air replacement. It is important to realize, however, that after almost a century of use the procedure has not found for itself a sufficiently secure place to become firmly established. It is interesting also that, beginning as early as 1876 with the report of Cresswell Hewett,[4] various methods of continuous closed drainage or continuous aspiration have been recommended from time to time. The procedures scarcely differ in any respect except in unimportant details. Again, as with the question of repeated aspirations, we must ask ourselves why methods of continuous closed drainage should find favor for a few years at a time, only to be forgotten and then re-discovered and applied by some one else.

The answer to this question seems to us to lie in the fact that the mortality rate in cases of empyema is dependent almost entirely upon the virulence of the epidemic of pneumonia, if the surgeon is not responsible himself for the deaths by creating an open drainage too early in the course of the disease. The recent recrudescence of enthusiasm for treating empyema exclusively by repeated aspirations or by continuous closed drainage is probably to be explained by the fact that in recent years the mortality rate from pneumonia and, therefore, from empyema, has been comparatively low. We venture to suggest that the periodic advocacy of such methods with an intervening lapse of years in which they are not advocated is due to the fact that the methods seem satisfactory during the years when the mortality figures are low but that when the mortality figures become high again the methods are advocated with less enthusiasm or completely forgotten.

A careful study of this question beginning during the war, while one of us was a member of the Empyema Commission, and carried on since then, has convinced us of several facts. The first and most important is that patients rarely, if ever, die from empyema itself. They die because of the complicating pneumonia, the presence of other severe complications such as brain abscesses, meningitis, peritonitis, *etc.*, or because they have had an open drainage created at a time when such an open drainage produces a fatal asphyxia. Another fact which has seemed to us to be firmly established is that if care is taken to avoid the creation of an open pneumothorax during the formative period of an empyema, it makes practically no difference so far as mortality is concerned whether the case is treated continuously by some form of closed drainage or by the institution of an open drainage after a true empyema, that is, a true abscess, is present. If one recognizes

the importance of the principle of avoiding an open drainage during the dangerous period while a pneumonia is still present and before there is an actual abscess of the pleural cavity, his mortality figures, regardless of what details he uses from then on, will be about the same as are those of the advocates of this, that or the other procedure.

If the fact is accepted that the mortality rate can be scarcely influenced by the details of treatment, provided always that the patient is not killed by the injudicious creation of an open drainage at the wrong time, then our attention should be directed to the second most important consideration in the treatment of empyema. This concerns the prevention of chronicity. The limited time at our disposal will prevent our giving a satisfactory and convincing discussion of this question. It will, therefore, be necessary to become somewhat dogmatic by saying that after trials of various procedures we have become convinced that the most satisfactory method of treating a case of acute empyema after it has really become an abscess is to drain it by an open drainage, and in our experience the most effective way to accomplish adequate drainage at this time is by the resection of a portion of a rib at the most dependent portion of the cavity. This procedure carried out over a period of years at the St. Louis Children's Hospital (see Table I) has enabled us to discharge the average patient with his cavity completely obliterated in a period of five weeks and two days from the time that the fluid was first recognized in the pleural cavity. Many cases were discharged in much less time but some required a longer time. This average compares favorably with, and we think on the whole is superior to, the average period of healing reported by those who adhere to methods of continuous closed drainage or repeated aspirations as a sole method of treatment. The question of irrigation of the cavity in our opinion is of only slight importance compared with the principle of avoiding an open pneumothorax during the formative period of the empyema.

TABLE I

*Cases of Empyema in which Surgical Drainage was carried out*

1925–1930 inclusive

St. Louis Children's Hospital

(Statistics Compiled by Dr. H. C. Ballon)

Number of Cases 116 Number of Deaths 13

Mortality 11.2 per cent.

| Year | Number of Cases | Healed | Dead | Percentage |
|---|---|---|---|---|
| 1925 | 15 | 15 | 0 | 0 |
| 1926 | 17 | 13 | 4 | 23.5 |
| 1927 | 11 | 10 | 1 | 9.0 |
| 1928 | 21 | 19 | 2 | 9.5 |
| 1929 | 23 | 19 | 4 | 17.3 |
| 1930 | 29 | 27 | 2 | 6.9 |

Of these, thirty-six cases were children two years of age and under, with eight deaths, a mortality of 22 per cent. Eighty cases were children over two years of age, with five deaths, a mortality of 6.2 per cent.

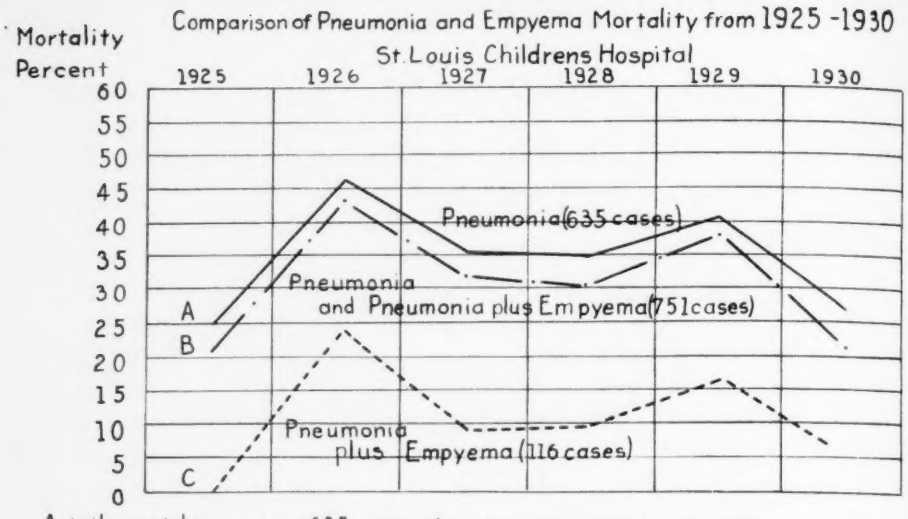
As a means of preparing patients for an open operation we usually employ aspirations from time to time as the occasion demands but sometimes we use a method of closed continuous drainage. We do not feel that these details are important.

Our chief bone of contention with those who emphasize details rather than principles and, therefore, particularly those who in recent years have advocated either continuous closed drainage, or repeated aspirations as the sole method of treating cases of acute empyema, is that the latter frequently convert an acute empyema into the more serious condition of a chronic one by allowing the most favorable time for open drainage to slip by. If they do not do this but instead create an adequate open drainage at the proper time then they are advocating only those procedures which we have recommended since 1918. As a matter of fact, Brenneman, who has been one of the leading recent exponents of aspiration as a sole method of treatment, has informed one of us that he is recommending an open drainage in more cases than he did formerly.

It is perhaps advisable at this point to call attention to the fact that nearly every case of acute pneumonia will reveal some fluid in the pleural cavity if an aspiration is performed. This fluid is serofibrinous or serohæmorrhagic. Even although leucocytes and bacteria may be found in it on microscopical examination, it does not indicate an empyema in the sense of a true abscess. In most cases this fluid will be absorbed as the pneumonia clears. Statistics, therefore, based on the recovery of such patients after aspiration or continuous closed drainage are often misleading.

While we were collecting data on the points involved in this paper Heuer's[5] excellent article appeared which also called attention in a striking way to the fact that the mortality rate of acute empyema is governed almost entirely by the severity of the virulence of the epidemic provided that the surgeon does not himself kill the patients by the injudicious creation of an open pneumothorax during the development of the empyema.

The accompanying curves (Figs. 1 and 2) show in a striking manner how closely the mortality rate of acute empyema has paralleled that of pneumonia in the St. Louis Children's Hospital over a period of years. This parallelism has occurred despite the fact that during the years represented the cases of empyema have been treated by a uniform procedure which has consisted of aspirations as often as indicated, to be followed by open drainage when frank pus, or a true abscess, is present. If only the year 1925 had been selected we might have concluded that we had an infallible method because no deaths occurred in that year. If, on the contrary, we had studied only the cases of the following year (1926) we should have felt that there was something radically wrong with our method because our mortality then was 23.5 per cent. The variation in the mortalities from year to year shows the futility of basing claims of superiority for a particular method of treatment on only a few cases or even a large series of cases treated over a period of only one or two years. This fallacy is probably the explanation of the

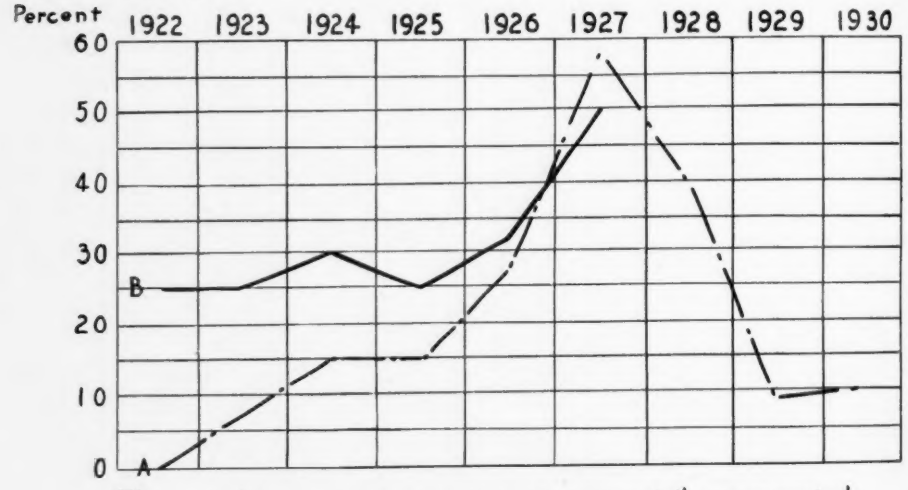



A is the mortality curve in 635 cases of pneumonia without empyema

B is the mortality curve of these 635 cases of pneumonia without empyema combined with the mortality of the 116 cases of pneumonia with empyema (combination of curves A and C)

C is the mortality curve of the 116 cases of pneumonia complicated by empyema

FIG. 1.—The mortality curve of cases of pneumonia without empyæma and that of cases of pneumonia with empyema over a period of six years has shown a remarkable parallelism. This is interpreted as indicating that there is something in common between the two conditions which largely determines the death rate. This determining factor is probably the virulence of the micro-organism. In this series all of the cases of empyema were treated according to a uniform plan which is described in the text.




The mortality curves of empyema and pneumonia by year periods. A, mortality rate in empyema by year periods; B, mortality rate in pneumonia by year periods (The mortality in pneumonia not determined for 1928, 1929, and 1930)

(Heuer: Acute Empyema, Vol 1, No. 5 June, 1932, The Journal of Thoracic Surgery).

FIG. 2.—The mortality curves of pneumonia and of empyema as found by Heuer at Cincinnati.

recrudescence of the over-emphasis of details which appears from time to time. The explanation of the fact that the death rate in patients who develop empyema is lower than that of pneumonia in general probably is that the development of an empyema (an abscess) is indicative of a considerable amount of resistance against the infection.

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DISCUSSION.—DR. HOWARD LILIENTHAL (New York City) remarked that empyema usually originates from the lung. There is first a small sacculation that gets larger until at last there develops a single, large, sacculated empyema. There may, however, be a condition in which there are two, or three, or four, or even five empyemas that start not even simultaneously but at different times and in different parts of the pulmonary surface. If they run together, the ultimate result is a large sacculated empyema. If they do not run together one may open one sac at a time.

He had drained as many as five empyemas with fluid containing three different organisms at one time in a single patient, in a single hemithorax.

He also called attention to the fact that a general empyema is an exceedingly rare condition and it is one in which the lung is represented by a small collapsed mass on its root as a pedicle. This is a very serious condition and one which is extremely difficult to cure.

As to the matter of treatment, his way is closed drainage in one form or another. If the patient is not relieved at the end of four or five days an X-ray picture is made. That will probably show another pocket. The point is that empyema is not always a single sac or cavity. Correct treatment means constant watchfulness, frequent physical examination and enough X-ray pictures.

DR. J. M. MASON (Birmingham, Ala.) said that in the Children's Hospital of Birmingham, for a time closed drainage was much favored, but in a series of forty cases which were carefully analyzed, the conviction was evident that open operation by rib resection, performed at a time when the pneumonia had subsided, the pus had become thick, and the mediastinum had become fixed, was the simplest method of treatment and was followed by the lowest mortality.

Simplicity in after-treatment is very important. It is not necessary to irrigate the pleural cavity in children, or to confine them long to bed, as is the case when they are attached to suction apparatus or while being treated by other cumbersome methods of drainage. We have simply established tube drainage through a rib resection at the proper time, have allowed the secretions to escape on gauze pads frequently changed, and have allowed the patients to get out of bed and into the open air at an early date. They have been more contented and have improved more rapidly than have those who were treated by longer confinement. In this series of forty cases, the average time of tube drainage was 27.5 days.

DR. CARL EGGERS (New York City) said that the points which Doctor Graham had made are points which he emphasized in a paper in 1919 after the observation of a

group of empyema cases in one of the southern army camps. (Empyema: Analysis of Seventy Cases. Surg., Gynec., and Obstet., p. 348, April, 1919.)

He went a step farther than Doctor Graham, and was able to divide the cases into those which followed a lobar pneumonia, and those secondary to bronchopneumonia. It became apparent to him that there is a great difference in the course and prognosis of empyema cases following lobar pneumonia and those following bronchopneumonia. The former is more likely to be a primary pneumonia, which attacks a patient suddenly, while the latter is more likely a secondary pneumonia, coming on after the patient is already weakened by some other disease such as measles, influenza, tonsillitis, or other infection. There is another important point to be borne in mind and that is the fact that lobar pneumonia is usually unilateral and often affects only one lobe, while bronchopneumonia is much more often bilateral and may affect all the lobes to some degree. This difference in cases is strikingly illustrated by the mortality in the two groups. While in the empyemas following a primary lobar pneumonia we had a mortality of only 12 per cent., it rose to 37 per cent. in those cases following a secondary bronchopneumonia.

In addition to the type of pneumonia preceding their empyema cases, they studied them in relation to the organism responsible for the infection. They made the observation that even at that time, in 1917 and 1918, when empyema mortality was very high, there was a vast difference in cases depending on the organism concerned. In fifty-four cases due to the pneumococcus, there was a mortality of 17 per cent., while in sixteen cases due to the streptococcus, there was a mortality of 62 per cent. That was one lesson.

Soon after that he had another important lesson pertaining to the virulence of the organism in different parts of the country and at different seasons. In a southern camp in which they followed the same form of treatment in the influenza empyemas which they subsequently used in a western camp, they had a mortality of 27 per cent., while in the western camp epidemic, in which the same organism predominated, there was a mortality of only 6 per cent. (Relative Value of Various Operative Procedures Employed in Acute Empyema. Jour. Am. Med. Assn., p. 995, October, 1920.)

These various observations have made them feel that it is very misleading to draw definite conclusions from one group of cases. In making comparative studies in empyema it is important not only to consider the form of treatment employed, but to bear in mind the antecedent disease, the type of pneumonia, the organism concerned and its virulence, the prevailing climatic conditions, whether cases are sporadic or those of an epidemic, the age of the patients, and whether complications were present.

Dr. George J. Heuer (New York City) remarked upon the studies which he had made based upon two large series of cases, a series in Baltimore which antedated the war, and a series in Cincinnati during the past ten years. It was shown conclusively, he thought, that the mortality in acute empyema depended much more upon the type of pneumonia which existed at the time and the presence and nature of other complications (lung abscess, pericarditis, septicæmia, *etc.*) than it did upon the kind of operative and post-operative procedures which were employed, so long as the principles which Graham established were carefully followed. He asked Doctor Graham if he had made any observations on the healing of empyema cavities which support or refute the observations he had made. In a rather small series of cases he made accurate repeated measurements of the volume of empyemic cavities after operation, as a result of which he came to the belief that the healing of empyema followed the same laws which apply to the healing of superficial and deep wounds. In other words, the healing of empyemic cavities follows the law which Carrel and Du Noüy expressed in connection with the healing of superficial wounds. This means—if his observations are confirmed—that empyema heals in the same way as any superficial or deep wound and that the same principles should be applied in the management of empyema as are applied in the treatment of other wounds.

DR. ALEXIS V. MOSCHCOWITZ (New York City) said that although primarily, he agreed with practically everything that Doctor Graham had reported in his paper, he could not fully agree with Doctor Heuer, provided he understood him correctly: namely, that an empyema heals like any other wound. In the healing of an empyema, one is dealing with certain important mechanical principles and these differ materially from the mechanics of other healing wounds. In an empyema, one is dealing with a cavity, one boundary of which is absolutely rigid, while the other is also more or less rigid, but never soft and yielding. The Carrel-Dakin method of treatment he continued to use and the method continues to give him perfect satisfaction.

DR. FRANK S. MATHEWS (New York City) remarked that when the chest wall is opened and access of air permitted, the tendency of the lung must always be to contract and leave the chest wall as a result of the intrinsic elastic fibres of the lung. The lung itself can make no active contribution toward its own expansion to fill the cavity but that it does expand is the result of positive pressure in the trachea and bronchi which occurs with forced expiration or coughing. One often sees the lung during an operation expand with coughing so as to forcibly eject fluid to a distance through the thoracotomy incision. To maintain the expansion that intermittently occurs in forced breathing there is nothing so efficient as a wet pad of gauze over the opening. This in no way interferes with the outflow of air or pus from the pleural cavity but it acts as a very definite barrier to the entrance of air with inspiration. If the physiology of the method by which the lung expands is kept in mind there is less temptation to replace the wet dressing by a closed suction drainage which, if the tube becomes plugged, at once stops drainage and interferes with the expansion of the lung as there is no longer free exit for air and pus.

DR. EVARTS A. GRAHAM remarked as to the point which Doctor Heuer spoke about last, being able to prophesy the time of healing of the empyema cavity he had found to hold true pretty generally in cases of empyema.

The limitations of time had prevented his going into a discussion of the differences in organisms, the relationships to systemic disease such as measles, scarlet fever and so forth.

He had grouped together the mortality figures of pneumonia regardless of whether they were due to streptococcus or pneumococcus because he thought the figures would be more striking if they showed the same parallelism to the mortality of empyema as if he had divided them separately into different kinds of organisms.

# TUMORS OF THE BONY CHEST-WALL

## A STUDY OF TWENTY-TWO PERSONAL AND SEVENTY-EIGHT COLLECTED CASES SINCE 1921

By Carl A. Hedblom, M.D.

of Chicago, Ill.

This paper is based primarily on the study of twenty-two personal cases and on seventy-eight collected from the literature since 1921. At that time I reported forty-eight cases from The Mayo Clinic and thirty-five collected from the literature. These added to 103 reported by Parham in 1898 and twenty-seven by Lund in 1913 make a total of 313 cases since the first thoracotomy for tumor recorded by Osias Aimar in 1778. In the study of this combined series the material collected by Parham, Lund, and Heuer who has made a study of twenty-seven cases between 1921 and 1926 has been especially valuable. Of the cases listed since 1913 the original records have been studied.

In this series, tumors of the soft tissues, including those of the breast, of the axillary glands, lipomata, hemangiomata, superficial dermoids, skin carcinoma, *etc.*, are excluded except for rare instances in which the bony thoracic wall was involved.

The dividing line between tumors that are primarily in the thoracic wall and those that involve it secondarily from within the thorax may be ill-defined clinically in some cases and the differentiation must then be somewhat arbitrary.

Of the total series of 313 cases twelve were metastatic to a lesion elsewhere. It would perhaps seem desirable to exclude all the secondary growths, but in some of them it has been impossible to recognize their secondary nature

Table I

| Pathological Classification | Collected up to 1921 | Personal and Collected 1921–1933 | Total |
|---|---|---|---|
| Chondroma | 40 | 14 | 54 |
| Fibroma | 5 | 2 | 7 |
| Osteoma—exostosis | 3 | 2 | 5 |
| Giant cell | | 1 | 1 |
| Sarcoma | 131 | 61 | 192 |
| Carcinoma | 24 | 12 | 36 |
| Endothelioma | | 3 | 3 |
| Myeloma | | 2 | 2 |
| Lymphangioma | | 1 | 1 |
| Lipoma | | 2 | 2 |
| Gumma | 1 | | 1 |
| Uncertain | 9 | | 9 |
| Totals | 213 | 100 | 313 |

until operation or necropsy. These cases therefore seem of some value in the study of differential diagnosis. Some have been treated as primary growths with marked palliative results.

The classification of these tumors is that of the main pathological types and their subdivisions.

TABLE II

*Relative Incidence of Types of Tumors in 143 Cases*

| Pathological Classification | Mayo Clinic and Present Series |
|---|---|
| Chondroma 12 | Fibrosarcoma 8 |
| Osteochondroma 5 | Lymphosarcoma 2 |
| Fibroma 3 | Angiosarcoma 1 |
| Periostitis 3 | Carcinoma 12 |
| Osteoma 2 | Epithelioma 1 |
| Lipoma 2 | Non-melanotic melano-epithelioma 1 |
| Giant-cell tumor 1 | Endothelioma 3 |
| Sarcoma 58 | Hypernephroma 5 |
| Chondrosarcoma 7 | Myeloma 1 |
| Myxochondrosarcoma 2 | |
| Osteochondrosarcoma 2 | |
| Osteosarcoma 9 | |
| Osteofibrosarcoma 1 | |
| Fibromyxosarcoma 2 | |

It will be noted that of thirty-four cases in which the type of sarcoma was specified it was of the chondroma type in sixteen cases.

In 261 (80 per cent.) of the 313 cases the tumors were of the ribs and in fifty-two (20 per cent.) of the sternum. Of seventy cases of rib tumor fifty were sarcoma and ten chondroma. There was one sarcoma and one chondroma of the sternum. The others were all metastatic.

The location of the tumor in sixty-four cases in the present series was as follows:

TABLE III

| | Right Side | | Left Side | | |
|---|---|---|---|---|---|
| | Sarcoma | Chondroma | Sarcoma | Chondroma | Total |
| Anterior | 16 | 3 | 9 | 3 | 31 |
| Lateral | 10 | 3 | 7 | | 20 |
| Posterior | 7 | 1 | 4 | 1 | 13 |
| Totals | 33 | 7 | 20 | 4 | 64 |

In sixty-five cases the upper thorax was involved in twenty-one; the middle portion in fourteen; the lower in thirty; a single rib was involved in twenty; two ribs in fifteen; three or more in twenty-three; seven in one case. In thirty-two sternal tumors, the manubrium appeared chiefly affected in ten; the gladiolus in seven; the xiphoid in one. The exact location of the others was unspecified.

In sixty-five cases the size of the tumor was variously described as that of a nut, apple, fist, grapefruit, man's head, *etc.* In centimetres their approximate equivalents would seem to be as follows:

TABLE IV

| | Sarcoma | Chondroma |
|---|---|---|
| Under 5 cm. | 5 | 5 |
| 6 to 12 cm. | 26 | 5 |
| 13 to 30 cm. | 21 | 3 |
| Total | 52 | 13 |

TABLE V

*Age and Sex*

| | 1921 Series | Present Series | Total |
|---|---|---|---|
| Under 10 | 3 | 12 | 15 |
| 11 to 20 | 25 | 17 | 42 |
| 21 to 30 | 36 | 17 | 53 |
| 31 to 40 | 39 | 11 | 50 |
| 41 to 50 | 28 | 14 | 42 |
| 51 to 60 | 33 | 17 | 50 |
| 61 to 70 | 15 | 8 | 23 |
| 71 to 80 | 2 | 2 | 4 |
| Not stated | 32 | 2 | 34 |
| Totals | 213 | 100 | 313 |

TABLE VI

| | 1921 Series | Present Series | Total |
|---|---|---|---|
| Males | 116 | 59 | 175 |
| Females | 70 | 39 | 109 |
| Not stated | 27 | 2 | 29 |
| | 213 | 100 | 313 |

Duration of the tumor

TABLE VII

| | Sarcoma | | Chondroma | |
|---|---|---|---|---|
| | 1921 Series | Present Series | 1921 Series | Present Series |
| Less than 1 yr. | 38 | 24 | 6 | 3 |
| 1 yr. to 6 yrs. | 60 | 15 | 12 | 4 |
| More than 6 yrs. | 12 | 4 | 8 | 4 |
| Totals | 110 | 43 | 26 | 11 |

*Etiology.*—Among sixty-one cases of sarcoma in this present series there was a history of trauma in thirteen; among the fourteen chondromata, in six. In five of the sarcomata the time between the trauma and the recognition of the tumor was between two months and three years. Ewing postulates that five conditions must be fulfilled before a casual relationship between trauma and tumor can be justified. These postulations are: (1) authenticity and

sufficient importance of trauma; (2) previous integrity of the wounded part must be established; (3) a reasonable time relationship of from three weeks to three years must exist; (4) the identity of the injured area with the site of the tumor must be established; (5) the nature of the tumor as established microscopically must be of a type that may be reasonably caused by trauma. Congenital tumors and lipomata are thereby excluded. In my case (VII) and in those reported by Harrington and by Morton, and in two cases by Becchini and in one by Zinninger these postulates seem fulfilled, except that the integrity of the part before the trauma usually cannot be proven. The fact that the male incidence of tumors is 60 per cent., and the further fact that 50 per cent. occur on the more exposed anterior and anterolateral portion of the thorax suggests that trauma that has been forgotten may play a larger rôle than is apparent. Operative trauma seems to accelerate the growth of an incompletely removed tumor as illustrated in my Case I. The apparent tendency for sarcomatous degeneration of chondroma is suggested by the frequent occurrence of chondrosarcoma and by the finding of such pathology in tumors that have been present for years (Zinniger, Beck, Harrington). In one case in this series a sarcoma developed during pregnancy. Amburger and Tretze record such cases. In Tretze's case a tumor grew in three periods following three successive pregnancies during nine years.

The apparent accelerating effect upon the growth of chondroma of incomplete removal is well illustrated in Case VI and in others previously reported.

Of the malignant tumors other than the sarcomata, twelve were carcinomata, three endotheliomata, one myeloma. Carcinoma was primary in the thyroid in two; in the breast in four; in the lip in one; in the kidney in three; in the eye in one. (Melanoma.)

*Symptoms and Signs.*—A swelling or bulging of the chest-wall or a definite mass is the most characteristic. Some degree of ache or pain is present in about half the cases. In many pain develops before there is any palpable or visible growth or bulging, as in my Case XIII and in those reported by Sourille and by Heurer. Busse records one case of myxochondrosarcoma which remained entirely intrapleural and which caused great pain, dyspnœa and finally the death of the patient.

Sarcomata are characterized by rapid growth and as the tumor enlarges, by a variety of other symptoms. Among sixty-one cases weight loss occurred relatively early in eleven, cough in eight, dyspnœa in six, cyanosis in three, pleurisy in three. Cord paralysis occurred in two and of the arm in one. Intermittent fever is not uncommon.

The pain may simulate other lesions. One of my patients with a tumor of the eighth rib was operated upon for gall-bladder disease because of pain localized in the right costal margin with spasm of the muscles.

Chondroma is usually of slower growth and as indicated in Table VII is of much longer average duration. The unreliability of pain in the differential diagnosis between sarcoma and chondroma is indicated by the fact that pain was present in nine of twenty-four cases of chondroma. The sudden onset

of pain in a previously symptomless tumor of long duration is, however, suggestive of malignant degeneration of a benign growth.

A smooth surface is suggestive of chondroma, an irregular nodular one of sarcoma, but this is an unreliable criterion inasmuch as a chondroma may be nodular and at any time may develop malignant change.

Röntgenological examination in a typical case of sarcoma or chondroma usually reveals a dense, well-defined shadow which may lie entirely outside the lung field or may encroach on it. In some the röntgenogram is negative. (Cases I and XVII.) The picture may be typical of an intrathoracic tumor and there may be a palpable tumor in case of one arising from the ribs and cartilages but projecting entirely into the pleural cavity. The pressure of a pleuritis with or without effusion may obscure the shadow even of a growth of considerable size.

*Diagnosis.*—In the presence of a large palpable tumor the diagnosis of a neoplasm usually is obvious but if the tumor is small or if it lies under heavy muscles or under the female breast (Turner) or if it extends chiefly or entirely intrathoracically it may be overlooked. Pain and other symptoms of mechanical origin may persist in any type of tumor and in other conditions.

The differential diagnosis includes a consideration of inflammatory swelling, cold abscess, exostosis, gumma, aneurism, dermoid cysts, substernal thyroid and, in case of an intrapleural lesion, encapsulated effusion, pleuritis, or an echinococcus cyst. Inflammations associated with osteomyelitis or chondritis, sometimes with fever and pain, may simulate a tumor. In one of my cases there was secondary degeneration of the growth with abscess formation. A small cold abscess firmly encapsulated in a rib may not fluctuate. I have operated on one such case under the mistaken diagnosis of neoplasm. Exostosis may be impossible to differentiate as in several of my cases previously reported and in the instance of Zinninger. The Wassermann test and the classical findings of syphilis should always be sought for. Aneurism is suggested in some types of neoplasm by the presence of a true or transmitted pulsation.

Aspiration by means of a small needle may be helpful but the finding of blood does not necessarily indicate aneurism nor does a dry tap entirely exclude it. In one instance I found an aneurismal sac partly filled with fibrin. Extrathoracic dermoid cysts of the thorax are rare. Intrathoracic dermoids in the anterior mediastinum, particularly those under the sternum or presenting in the neck of which there are (?) on record, are not unlike other neoplasms. Dermoids also not infrequently produce a bulge of the anterior chest-wall. A substernal thyroid usually but not always can be shown to be connected with the thyroid in the neck. I have operated upon one patient for intrathoracic goitre the size of a large orange under the mistaken diagnosis of a tumor. An encapsulated pleural effusion that simulated tumor can be differentiated by the aspirating needle.

The recognition of the metastatic nature of a tumor of the chest-wall following operation for breast cancer or in the presence of a malignant tumor elsewhere usually presents no difficulty. In some cases, however, the primary growth remains latent for some time until after the chest-wall tumor has attained considerable size. In one case in my series the patient had a cough and purulent sputum in which actinomyces were found microscopically. A large bulging tumor developed on the anterior chest-wall. Biopsy showed inflammatory tissue. The röntgenogram presented a typical, round, well-defined shadow characteristic of an encapsulated tumor. It was found to be encapsulated outside the pleura and was removed. Necropsy some weeks later revealed a primary pulmonary carcinoma. In another case, previously reported, a primary carcinoma of the adrenals was found at necropsy six months after the successful resection of a large encapsulated chest-wall tumor, showing histological findings characteristic of hypernephroma.

Careful study of the urine may show malignant cells in cases in which there is no blood (Macleod and Jacobs). I recently found a large hypernephroma in a patient whose urine had been consistently negative for several weeks.

The differentiation between benign and malignant primary growths can be made with assurance in some cases but in others it must be tentative only. A rapidly growing tumor is usually sarcoma, but one that has been present for years may show malignant degeneration, which is suggested by a sudden onset of rapid growth after long quiescence. Chondroma may, however, show similar abrupt exacerbation of growth as in a case reported by Heuer. Such a chondroma is malignant in the sense that it occurs, metastasizes and kills the patient. Lipomata may recur (Stammler) and may take the life of the patient if not removed (Walze). The finding of Bence-Jones protein as in one of my cases in this series is significant of myeloma.

*Treatment.*—As in the case of tumors in general early diagnosis and radial extirpation offers the best prospect for a cure. If every tumor of the chest-wall is considered potentially malignant it will result in the removal of exostoses, hypertrophied cartilage, fibromata, *etc.*, in the pre-malignant stage and in case malignancy is already present the outlook is perhaps better at the expense of a much less extensive operation than that which may become necessary later. Chondromata removed early show a much less marked tendency to recur than those of long duration. Some, after years of indolence, abruptly begin to grow rapidly and then recur and metastasize soon after removal. Operative trauma seems to stimulate any residual tissue to such activity. It is therefore of the greatest importance that they be removed entirely and with wide margins of healthy tissue.

Sarcomata of the thoracic wall show the same tendencies to recur and to metastasize as those located elsewhere. The outlook as to permanent cure is bad but marked palliation may be expected in a large proportion following early operation, and in case of some, many years have been added to the patient's life.

Local recurrent carcinoma, particularly following radial operation for carcinoma of the breast, offers a better prospect of palliation by radial resection of the chest-wall than the usual hopeless attitude towards them would seem to indicate. A fair proportion of the relatively few cases subjected to secondary radial operation have been free of further recurrence for years.

Palliation only is to be expected from radial extirpation of metastatic tumors but when the diagnosis of a primary growth elsewhere is uncertain it gives the patient the benefit of the doubt.

The value of radiotherapy as compared with radical extirpation of malignant tumors has not been determined. There is good evidence that it is of very definite value in some cases, in others it seems entirely ineffective. A judicious combination of surgery and radiotherapy probably promises the best results.

In case of primary growths the indications and contra-indications for surgical extirpation rest largely on the nature of the tumor and the general condition of the patient. The hazards of open pneumothorax of the earlier days have been largely overcome by the use of simple positive pressure anæsthesia and air-tight closure of the thorax after re-inflation of the lung. The residual air in the pleural cavity can be aspirated after closure by a pneumothorax apparatus.

The indications for the removal of a so-called "benign" chondroma or other non-malignant tumor are wider than for removal of a sarcoma, both with respect to the extent of the growth, and as to the condition of the patient. Often the nature of the tumor is in doubt until after its removal, but in cases border-line of operability, biopsy will establish the diagnosis before extirpation is undertaken.

The presence of metastases from a chest-wall tumor will usually contra-indicate operation, but the diagnosis of such metastasis may be erroneous as in a case reported by me in my earlier publication.

Infiltration and extension of the tumor beyond that recognizable clinically may be found at operation. In a number of such cases very extensive operations with resection of a large number of ribs have been reported, some with surprisingly good results. Some such cases will be referred to below.

In my own series of thirteen cases of sarcoma herewith reported five were subjected to radical resection, three had recurrence and two of these died within six months. Two had no recurrence, one and two years later, respectively. In the present series of sixty-one cases a radical resection was performed in thirty-five. One died of pulmonary embolism and two from uncertain causes shortly after operation. Nine were known to have died of recurrence, five within six months, one in ten months; two between one and two years, and one after four years. Of the remaining twenty-three, seven were without recurrence under six months, three between seven months and one year, three between one and two years. Speed's[41] patient was free of

recurrence four and one-half years. Three were living but had shown recurrence, two under six months, one over one year. The fate of six after leaving the hospital was not stated. Lockwood's patient is here recorded as having a recurrence within one year but this was following a third operation for recurrence. He lived between three and four years from the time of the first operation. It will be noted, therefore, that of the whole group subjected to radical operation, eight are known to have lived from one to four and one-half years following it.

Among sixty-five cases of sarcoma previously reported fifteen (23 per cent.) were known to have been free of recognizable recurrence one year or more after operation. One patient in The Mayo Clinic series was symptom-free for eight and one-half years. One patient in the same series presented himself with a recurrence after four successive operations performed thirty-two, eleven, two and one year previously.

In Parham's series of twenty-five sarcomata, eight (33 per cent.) were reported free of recurrence for one to five years.

Palliative excision was done in eight of the sixty-one cases. One patient who had had a slow-growing tumor for fourteen years, sarcomatous at operation, was reported free of recurrence two years after local excision and cautery. Another lived one and one-half years after local excision.

Radiotherapy in the form of Röntgen-ray or radium treatment or both in various dosages was used together with operation in a considerable proportion of the cases. It is naturally impossible to evaluate its effect under such conditions. In most of the cases in which radiotherapy was the sole method of treatment, the results are not given. Goulliard[12] has reported one patient treated with radium alone living and free of recurrence for four years. Becchini[2] had one treated by radiotherapy alone who died of recurrence after twenty-eight months. Speed states that his patient, who is living and symptom-free after four and one-half years, and has since borne two children, had had no radiotherapy at any time.

Of fifteen patients subjected to biopsy alone, or with some radiotherapy, six were reported to have died within six months.

Among six cases of chondroma in my series five were subjected to radical operation and all remained free of recurrence from one to two years. One who had had two previous resections elsewhere, and on whom I did a palliative resection only, followed by massive radium treatment, was reported by her family physician to have developed further recurrence a few months later.

In one case at The Mayo Clinic I resected the whole sternum with part of the costal cartilages for an extra- and intrathoracic recurrent chondroma the size of a large coconut. The patient was in extremis with dyspnœa and cyanosis. He survived the operation surprisingly well but died about a week later with symptoms of cardiac exhaustion from respiratory embarrassment apparently due to the abnormal mobility of the chest-wall on both sides. It

seems likely that he might have survived had it been possible to splint the ribs or if a Drinker respirator had been available.

Of the eight cases in the collected series seven were subjected to radical excision. Recurrence developed in the case of a huge substernal chondroma reported by Heuer in which he resected the lower two-thirds of the sternum with a tumor measuring ten by ten centimetres and with brilliant immediate result, but recurrent nodules were found at a second exploratory incision a few months later. One case of rib chondroma reported by Nigst,[32] with successive involvement of four ribs posteriorly, had not been operated upon at the time of his report.

At the time of my earlier series of thirteen personal and collected cases there was no known recurrence but one patient developed a recurrence after six years.

Among the cases of malignancy aside from sarcoma there were two radical resections for primary endothelioma. (Harrington.) One patient died four months later, one was free of recurrence six months after operation. There were three instances of radical resection of the chest-wall following recurrence after radical breast amputation for carcinoma. One died seven months later of metastases, one lived one year after the second operation for recurrence which was nine years after the breast amputation, one was living without recurrence seventeen and one-half years after the breast amputation. (Denk.) Several successful cases are cited in my earlier publication.

Nordenfelt records one resection of the chest-wall for carcinoma but does not give the site of the primary growth. There were evidences of metastases four months later.

In case of the metastatic growths from hypernephroma and malignant thyroid no radical resection was attempted.

All the benign tumors listed were successfully removed. The giant-cell tumor in my series of the eighth rib is the only one I find recorded involving the ribs. The patient is well eleven and one-half years later.

An extrapleural and intrapleural lipoma weighing 400 grams successfully removed by Walze in an infant five months old represents a truly lifesaving achievement. The periosteal lipoma removed in two stages by Stammler, and which recurred but disappeared following radiotherapy, is another unusual type of chest-wall tumor.

SUMMARY.—(1) Tumors of the bony chest-wall are relatively rare. Among 313 cases, including twenty-two herewith first reported, about 17 per cent. were chondromas and 5 per cent. benign growths; about 61 per cent. were sarcomas and 13 per cent. other malignant neoplasms. Nine were of uncertain type. The ribs were primarily involved in 80 per cent.; the sternum in about 20 per cent.

(2) Trauma seems to be etiological in an uncertain proportion of chondromas and in both primary sarcomas and chondrosarcomas.

(3) Pain is the most characteristic symptom of both chondromatous and sarcomatous tumors. It may develop before a mass is recognizable clinically or röntgenologically.

(4) Aspiration or biopsy may be necessary to exclude other lesions and to establish the nature of the tumor.

(5) Early radical extirpation offers the best prospect of a cure. Late operation, even in the presence of an extensive spread of a malignant growth, may result in prolonged freedom from recurrence.

(6) Exploratory thoracotomy may be indicated in case of doubtful operability.

(7) Positive pressure anæsthesia largely removes the immediate risk of open pneumothorax and re-inflation of the lung before closure lessens the liability to post-operative respiratory embarrassment and to late pleural complications.

(8) Operability can be extended by a graded operation.

(9) Recurrence may develop following operation for chondroma and is the rule in sarcoma but life may be made more comfortable and may be much prolonged and there is a possibility of a cure.

(10) In view of the added safety of radical operation afforded by modern methods increased consideration should be given to radical resection of the chest-wall for the relative frequent local recurrence after amputation of the breast for carcinoma.

CASE REPORTS

CASE I.—L. N. G., female, aged sixty-one, came to The Mayo Clinic November, 1922, because of a recurrent tumor over the sternum.

Seven months before, a tumor two to three centimetres had been excised from the sternum. The pathological diagnosis was chondroma. Four months later a recurrent tumor was removed. A second recurrence developed during the succeeding three months.

On examination an indefinitely outlined, hard, non-tender mass was noted over the lower sternum and left costal cartilages and apparently fixed to these structures. The physical examination otherwise showed normal findings. The urine showed a few pus cells only. Röntgenogram of sternum showed normal findings.

At operation an irregular hard tumor mass was found involving the fourth left costal cartilage and extending down below the normal level of the cartilage perhaps a centimetre and extended along the sternal margin about to the junction of the gladiolus with the manubrium. The tumor was removed with a curette and by sharp dissection from the sternal margin where it was attached to the periosteum and the whole area was then thoroughly cauterized with the actual cautery. Three fifty-milligram tubes of radium were then placed in the cavity and the wound was closed, leaving the threads attached to the radium outside. She was dismissed in good condition on the eleventh day.

The operation was considered palliative only and the prognosis poor. The patient and family had decided against a radical resection of the sternum because of the risk involved and because no assurance could be given of a cure following it.

A month later the patient received a second radium treatment.

Two months after this her family doctor reported that there was some necrosis from the massive irradiation and that there was evidence of recurrence both laterally and under the sternum.

CASE II.—Female, aged thirty-eight, entered The Mayo Clinic April 19, 1922, because of a tumor of the eighth rib posteriorly discovered on a röntgenogram.

In 1907, she injured her back in a fall and was confined to bed for a week for this injury. She had no further symptoms referable to this episode until in the Spring of 1919 when she developed a constant severe knife-like pain in her left side from the back

to the breast which prevented sleep. The eighth intercostal nerve had been sectioned with complete relief of the pain for three months but it then recurred as severe as before but limited to the back as far as the axilla. She could not lie on her back or right side. In November, 1921, a röntgenogram showed an irregular elongated tumor of the eighth rib. She had had an hysterectomy for "fibroids" and appendectomy in 1908.

Examination revealed tenderness over the dorsal spine and laterally at the level of the seventh, eighth and ninth ribs but no other abnormal findings. Röntgenogram showed a destruction of the proximal end of the eighth rib on the right. The differential diognasis lay between giant-cell tumor and sarcoma with the possibility of chondroma, myeloma or hemangioma. The patient went home and returned May 18, 1922, for operation.

At operation the proximal end of the rib was found to be enlarged to three or four times its normal diameter. It was very friable and very adherent to the surrounding structures, and extended from the articulation with the transverse process outward about seven centimetres. The rib was sectioned well beyond the tumor area and enucleated from its articulation with the transverse process and spine. The wound was closed in layers. The specimen was seven centimetres long and two and one-half centimetres in breadth and thickness and showed practically complete disorganization of the bone. The pathological report was giant-cell tumor.

The convalescence was complicated by a bronchopneumonia of severe grade with delirium, but with complete recovery. She was discharged with wound healed and in good condition on the twenty-first day after operation.

In April, 1924, the patient reported that X-ray showed no evidence of recurrence.

In April, 1933, seventeen years after operation, her physician reported that the röntgenogram showed regeneration of bone at the site of operation, but Doctor Bloodgood who examined the plate expressed the opinion that it was not a recurrence.

Case III.—L. M., male, fifteen years of age, entered Augustana Hospital in February, 1926, because of a swelling in the right side, and was referred by Dr. Anders Frick. About nine months before admission, some weeks after a severe blow in the right chest he first noticed occasional dull aching pain in the right chest just above and to the outside of the nipple. About five weeks before admission he first noticed a small lump in this area which had grown considerably since. One night two weeks before admission he was awakened from sleep by an acute stabbing pain in the region of the tumor.

On examination a sausage-shaped tumor about four centimetres in transverse diameter and raised about one and one-half centimetres above the surrounding area was found in the region of the fourth rib in the mid-axillary line and extending backward under the scapula. It appeared firmly attached to the deep structures but the skin which appeared normal and moved freely over it. The boy was pale and thin. The thyroid gland was symmetrically enlarged and he had definite tremor of the hands. There was a widely transmitted mitral systolic murmur. The pulse was 88, temperature 99.4°. The hæmoglobin content of the blood was 75 per cent. Röntgen-ray examination showed a dense shadow in the region of the tumor encroaching considerably on the lung field. The pre-operative diagnosis was sarcoma of the chest-wall.

February 8, under local and nerve-block anæsthesia through a curved incision from the sternum to the posterior axilla the flap including the pectoralis muscles, the tumor was exposed. The tumor was found to involve the fourth rib and to completely fill the adjacent intercostal spaces and to extend from near the costochondral junction beyond the vertebral border of the scapula. Because of its extend and the relative poor condition of the patient it was considered inadvisable to attempt complete removal in one stage. The fourth cartilage and the third and fifth ribs were resected as far proximally as accessible. The non-adherent lung was sutured to the chest-wall with catgut and the wound closed.

One week later under nerve-block anæsthesia through a paravertebral incision the remaining proximal segments of the third and fifth ribs and the fourth to within three

centimetres of the tumor were resected and the lung sutured to the chest-wall in this area.

One week after the second stage under positive-pressure gas anæsthesia the flap made at the first operation was turned up and the previously mobilized tumor mass was removed with intercostal tissue and parietal pleura. The lung did not collapse because of the pleural adhesions but there was a little air aspirated through a leak at one point.

The convalescence throughout was uneventful. There was no pleural effusion.

The boy was discharged in good condition about four weeks after the first operation. During the next two months he received several deep X-ray treatments under the direction of Dr. Henry Schmitz. He gained in weight and strength. During the third month he began to lose weight and developed pain in his right chest and the röntgenogram showed findings suggestive of recurrence.

An exploratory intercostal thoracotomy was performed June 17. A soft pulpy tumor mass was scraped out of a large intrapleural cavity and the wound closed without drainage. He returned home June 28 and died a few weeks later.

Case IV.—A. W., male, aged four, came to the clinic August 1, 1921, because of a recurrent tumor of the left lower chest-wall, which was a recurrence of a tumor removed three months before elsewhere. The tumor was first noticed a year before admission which grew to the size of a hen's egg at the time of the operation a month ago. The doctor who removed it thought it was a lipoma but the biopsy of the tumor showed sarcoma.

His parents brought him to the clinic three months before this time, one month after the first operation. Examination at that time showed no tumor. He was given X-ray and radium treatment and discharged.

On examination at the second visit a tumor mass was felt over the lower anterior aspect of the left chest, which seemed fixed to the ribs, but the skin over it was freely movable except in the centre under the scar of his former operation. A Wassermann test was negative. The blood hæmoglobin showed 66 per cent.

At operation the eighth, ninth, tenth, eleventh and twelfth ribs were resected through a curved incision along the lower half of the circumference of the tumor. The tumor mass was found to involve the ninth, tenth, eleventh and twelfth ribs. The tumor mass was dissected from the peritoneum bluntly and lifted upwards. The pleural reflection at the costophrenic sinus was now sutured to the intercostal tissues below the excised eighth rib to the diaphragm. In this way the pleural cavity was walled off so that there was no pneumothorax. Tumor was then entirely removed and the wound closed without drainage. *Pathological Report.*—Sarcoma.

Patient's convalescence was marked by rather high pluse rate for the first few days and some temperature. He was discharged on the fifteenth day after operation, after having received radium treatment. Two months later when he was brought back for further radium treatment a recurrence was noted on the left chest-wall but he seemed well and very active and had lost no weight. He was given further radium treatment. January 31, 1932, he returned for another treatment and his mother stated that the tumor present in November had promptly disappeared but two weeks ago two other masses were noticed. On examination at this time, January 31, four distinct tumors were felt on the left anterior chest-wall, for which more radium treatment was given. February 3, a secondary operation was done and two encapsulated tumors, one four by two and one-half centimetres, one three by five by seven centimetres, were enucleated. These masses were not adherent to the peritoneum. The peritoneum was opened in dissecting them out. The third mass over the anterior ends of the cartilages of the seventh, eighth and ninth ribs, was about two by one-half centimetre. The beds of the ribs were cauterized with the electric cautery and the patient given further radium treatment. He was dismissed from the hospital on the sixth day and was given further radium treatment. The average dosage of the radium was from 9,000 to 12,000 millicurie hours each treatment. About six months later his father reported that he had developed further recurrences and had died.

CASE V.—A. M., male, aged seventy, came to the clinic March 6, 1922, because of swelling and pain in the left chest. Six years before he had been struck by a bull in the left chest. The swelling was painful most of the time. On examination a mass was found on the left chest-wall oval in shape six by six centimetres in diameter. It was painful to pressure, the veins over the tumor dilated. Röntgen-ray showed a shadow over the second and third ribs anteriorly on the left.

At operation a tumor mass which was soft, very vascular, somewhat expansile was found over the second and third ribs. The second, third and fourth ribs were separated proximally and distally to the tumor. About fifteen centimetres of the fourth rib were resected. The pleura was not adherent. The lung was sutured to the intercostal tissue by continuous chromic catgut sutures. The wound was closed without drainage. Ten days later the wound was opened up and the tumor removed with the ribs and intercostal

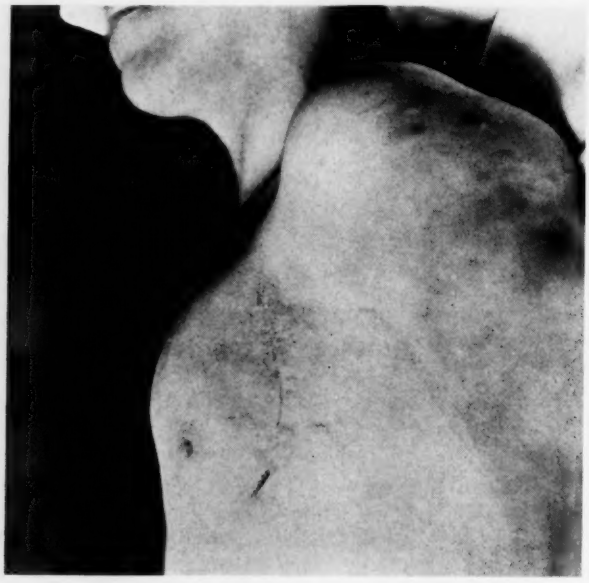

FIG. 1.—Tumor of left upper anterior chest-wall. Photograph taken following first-stage operation.

tissue and pleura. There was small pneumothorax collapse from leakage at one point but this caused the patient no symptoms. He was discharged three weeks after the operation in good condition after having received a course of radiotherapy. Six months later he returned for further radiotherapy. There was no evidence of recurrence at that time.

CASE VI.—J. G., male, aged thirteen, came to the Research and Educational Hospital October 25, 1927, because of a lump in his left anterior chest-wall. He first noticed a mass there two years before, a few months after an injury in this region. It had been removed in June, 1927.

On examination a mass about five centimetres in diameter was felt over the eighth left rib in the mid-axillary line where there was a linear scar from his former operation. Physical findings were otherwise not noteworthy. Röntgenological examination showed the findings of a tumor located outside the pleural cavity. At operation the mass was found to involve the eighth rib only in an extent of about six centimetres in its long diameter and was about four centimetres in transverse diameter. The tumor was removed with the periosteum and about five centimetres segment of apparently sound rib proximal and distal to it. Microscopical examination showed fibrosarcoma.

January 14, 1929, he returned because of a second recurrence of the tumor. He also complained of soreness in his left abdomen and groin. Physical examination at this time showed an irregular oblong mass of about the same diameter as before. The röntgenogram showed a diffuse shadow laterally and there was a shadow at the apex of

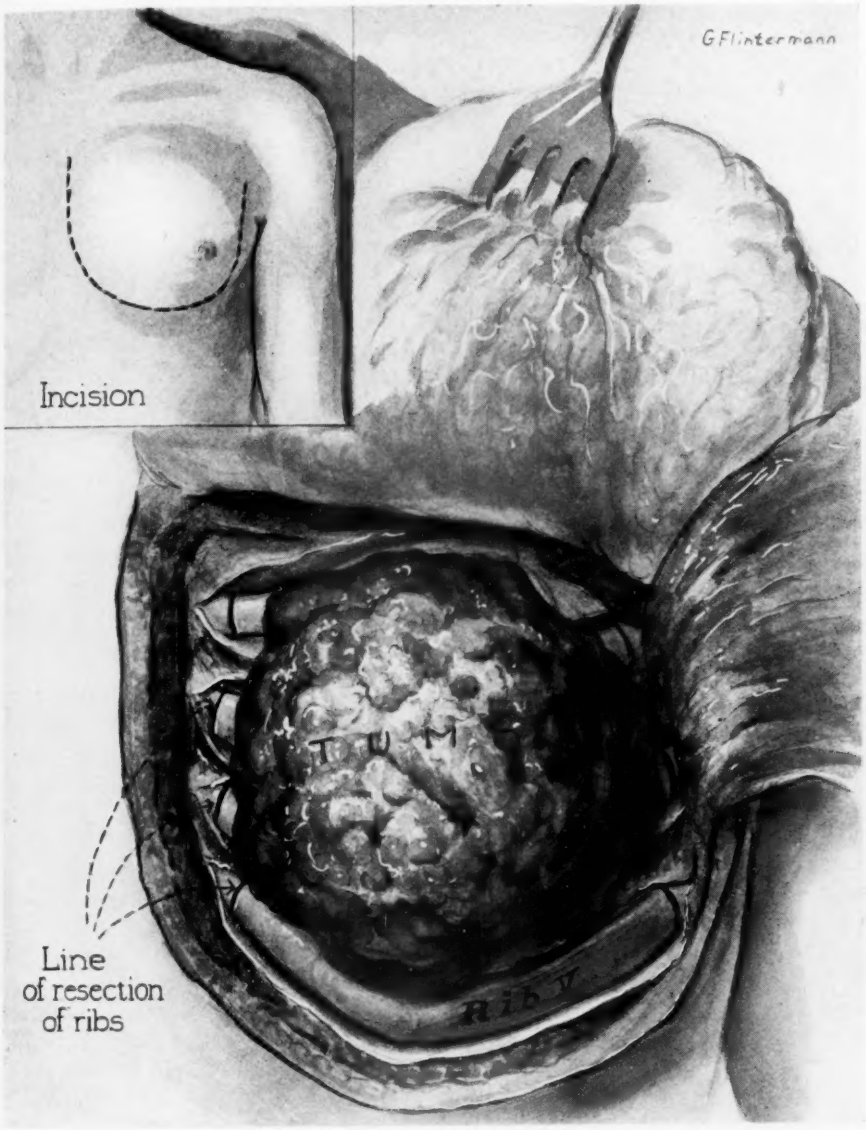


FIG. 2.—Drawing showing section of second, third and fourth ribs, first-stage operation.

the left lung which Doctor Hartung considered to signify a possible pulmonary metastasis. The tumor mass, irregular in outline, about five centimetres in its longest diameter but which showed no evidence of having involved the adjacent ribs, was removed with all adjacent tissue down to the pleura. The pathological diagnosis was giant-cell type of osteogenic sarcoma.

During the following months he received a number of Röntgen-ray treatments. When last seen three years after the second operation there were no signs of recurrence.

CASE VII.—F. D., male, aged thirty-seven, in February, 1932, was thrown from a wagon in a collision with an automobile and sustained a fracture of both bones of the right leg. About five months later he first noticed soreness and a swelling of the left anterior chest-wall (Fig. 1) which has gradually increased in size during the eight months that had elapsed before the examination which revealed a hard mass about seven to ten centimetres in diameter and elevated about three centimetres above the other side. It felt smooth and fixed to the ribs. X-ray showed a loss of substance of the third left rib near the costocartilaginous juncture. The diagnosis was osteochondroma.

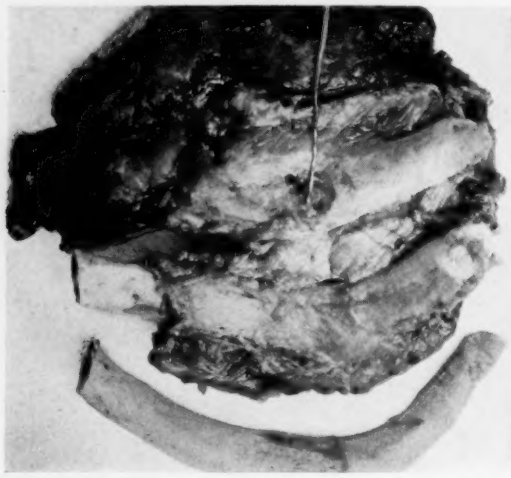

FIG. 3.

FIG. 4.

FIG. 3.—Specimen removed at second-stage operation. The pleuræ were adherent but not involved in the tumor. Pleural cavity not opened.
FIG. 4.—Microphotograph. Same case as Fig. 3.

The tumor involving the second and third ribs (Fig. 2) was removed by a two-stage operation. At the first operation under local and nerve-block anæsthesia the third and fourth ribs which were involved in the tumor were resected proximally and distally to the tumor and about twelve centimetres of the fifth which was not involved was resected subperiosteally. The lung was not adherent. An iodoform gauze pack was placed against the parietal pleura and the wound closed without drainage.

At the second operation two weeks later the tumor was removed without opening into the pleural cavity. (Figs. 3 and 4.) The tumor was about eight centimetres in diameter. Microscopical examination showed osteochondroma. The convalescence following both operations was uneventful.

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Discussion.—Stuart W. Harrington, M.D., of Rochester, Minnesota, remarked that tumors, particularly those which originate in, or which involve, the thoracic wall, often present greater technical difficulties than those that are entirely contained within the thoracic cavity. This is particularly true in relation to the technical problem of reconstruction of the thoracic wall following removal of large growths which involve it.

He preferred an operation in one stage when possible. He had removed these growths by operations in multiple stages, but in many instances had found that the second stage was more difficult technically, and more hazardous to the patient. Many of these growths are so situated that the operative procedure cannot be satisfactorily interrupted for performance in stages, and though the risk may be considerable it is best to complete the operation at one sitting. When growths involve the thoracic wall close to the diaphragm, or the thoracic wall and the diaphragm, the defect in the thoracic wall and diaphragm often can be closed by utilizing the paralyzed diaphragm after phrenicotomy. When growths involve the posterior wall the scapula can be utilized to cover large defects, with no marked limitation of its function.

When tumors involve the anterior thoracic wall, and this refers particularly to chondromas which project into the pleural cavity, he preferred to remove the tumor from the pleural side, by a posterior intercostal incision after allowing the lung to collapse. The posterior approach entails less disturbance of the thoracic wall and allows more secure closure of it. In one case, he had had pulmonary hernia result from extensive anterior resection of the thoracic wall. This is prevented by the posterior approach.

The large majority of primary tumors of the thoracic wall are malignant. In his experience of forty-three cases, approximately 85 per cent. of the tumors were malignant, and he thought that all were potentially malignant. The results from operation on benign tumors are very good, but the results in cases in which the tumors are malignant are not so satisfactory, for the tumors usually are of an infiltrating type and of a relatively high grade of malignancy. The average length of life following operation for malignant tumors has been about two years, although he had one patient with osteofibrosarcoma who is living and well more than six years following operation.

Dr. William B. Coley (New York City) recalled Doctor Lilienthal's case of mediastinal sarcoma which was reported before the New York Surgical Society in 1916 (see Annals of Surgery, April, 1927); and with his permission showed some lantern slides of it. The patient, a little girl aged two years, was brought to the Clinic of the Hospital for Joint Diseases, March 21, 1924, with the following history: At the age of five months the mother noted that the child's breathing was distinctly labored but nothing wrong with the lungs could be found. At the age of eight months a lump "on the right shoulder blade" appeared. An X-ray picture was taken at the Babies' Hospital, and reported on as follows: "A large, roughly quadrilateral dense shadow in the lower part of the right chest extending over the heart; also into the left chest and down over the liver shadow."

At the age of twenty-one months the child suddenly stopped walking because of weakness of the right lower extremity. This became rapidly progressive. At the time of Doctor Lilienthal's examination on April 12, 1924, both legs were flaccid and obviously paralyzed. There was a protruding subcutaneous mass covered with normal skin between the right scapula and the spine. X-ray examination showed a large mass in the right chest extending across the median line into the left chest above the heart. There appeared to be partial erosion of the adjacent ribs posteriorly and also some erosion of the bodies of the neighboring vertebræ. On April 15, Doctor Lilienthal performed a posterior thoracotomy, removing a considerable amount of soft, grayish-red neoplastic tissue. This was examined microscopically by Dr. F. S. Mandlebaum who pronounced it an angiosarcoma. Sections were examined by Dr. Louis Gross, also, whose diagnosis was that of hemangio-endothelioma. In the opinion of Doctor Ewing it was a very malignant cellular tumor of embryonal type.

On April 25, 1924, the patient was put upon Coley's toxins. The family physician, started with a dose of 1/25 minim, and increased this gradually until on the eleventh day a dose of 4½ minims was reached. Rather severe reactions followed. Three weeks after the operation, the child began to walk. The X-ray pictures showed gradual disappearance of the tumor; the one taken on October 16, 1926, revealed a normal chest. The child made a complete recovery and was in excellent health when he presented her to the members of the American College of Surgeons in October, 1931 (seven and one-half years later), and to the staff of the Memorial Hospital in the fall of 1932 (eight and one-half years later). In this case (1) The tumor involved both bone and soft parts. (2) The disease was so far advanced that the patient was nearly moribund at the time the treatment was begun. (3) The short duration of treatment, only eleven doses of toxins. (4) Coley's toxins alone were used; no other treatment. (5) The patient made an immediate and rapid recovery and was still well eight and one-half years later.

# COMPLICATED CONTRACTURES OF THE HAND; THEIR TREATMENT BY FREEING FIBROSED TENDONS AND REPLACING DESTROYED TENDONS WITH GRAFTS

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*The hand of the working man is his most valuable asset. Without it life becomes a burden.*—Kanavel.[17]

The restoration of function in a finger or hand rendered useless as a result of injury or infection frequently appears a hopeless task, and yet the function of the hand is so important to the patient that one is justified in considering very seriously every method that offers a possibility of bringing about the desired result. The importance of substituting normal skin and subcutaneous tissue for firm and extensive superficial scars before carrying out operative procedures on the deeper structures of the hand and forearm, of uniting divided nerves and bringing divided tendons into end-to-end apposition when this can be accomplished, and of mobilizing stiffened joints of fingers or wrist by extra-articular operation, by arthroplasty or by splinting and well-directed physical therapy, or by a combination of these methods, is well recognized by every surgeon who is interested in the reconstructive surgery of the hand. In many cases of complicated contracture replacement of superficial scar tissue by a flap of normal skin and subcutaneous tissue and mobilization of stiffened joints must be carried out as the first and second steps in the reconstructive process* and in many cases nerve suture may also be an essential part of the operative treatment. Without further consideration of these important and accepted methods of treatment we wish to pass on to the discussion of two methods that we have found of value in the treatment of seriously injured hands—freeing of fibrosed tendons, and substitution of tendon grafts for destroyed or hopelessly injured tendons or to fill the gap between the markedly retracted ends of divided tendons.

We would be the last to infer that this problem is a new one or that it has not previously attracted thoughtful study and serious consideration. Some of the ablest minds of the surgical profession in our own country and abroad have devoted careful clinical and experimental study to its solution. The work of Kanavel, Bunnell,[6, 7] Mayer,[25, 26] Steindler,[27] Lyle,[22] Lewis,[21] Auchincloss,[1] Taylor,[29] Cleveland,[8] Garlock,[9, 10, 11] Mason,[23] and Iselin[12] is

* "Joints must be mobilized before tendons are repaired or no motion will result. We cannot expect a newly repaired tendon to move a stiff joint; nor should we repair a bone, and at the same time a tendon or joint. The former demands post-operative immobilization, and the latter mobilization." (Bunnell.[5])

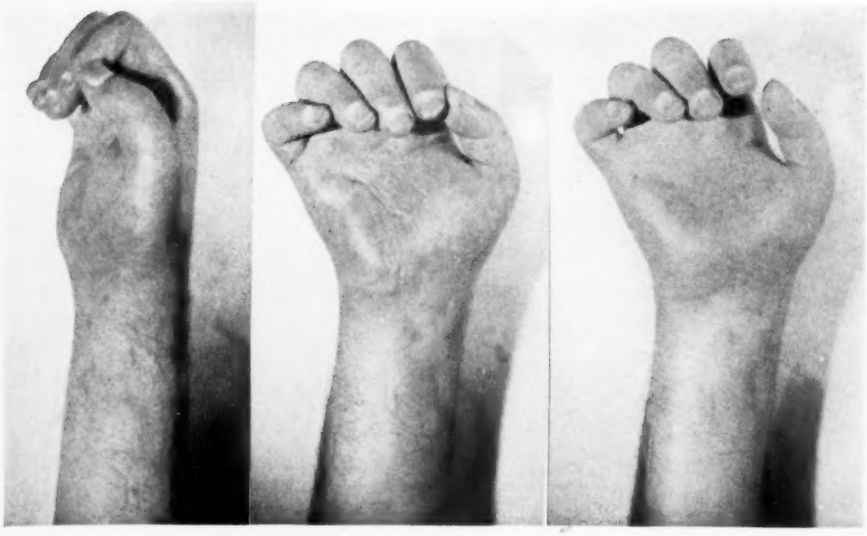

FIG. 1.—Flexion contracture of fingers and thumb secondary to an acute spreading infection of the hand and forearm. The fingers are almost completely fixed; a very slight movement of the thumb away from and toward the index finger are the only movements possible. There is a complete ankylosis at the wrist-joint. Healing is still too recent to permit operative interference without danger of lighting up a latent infection.

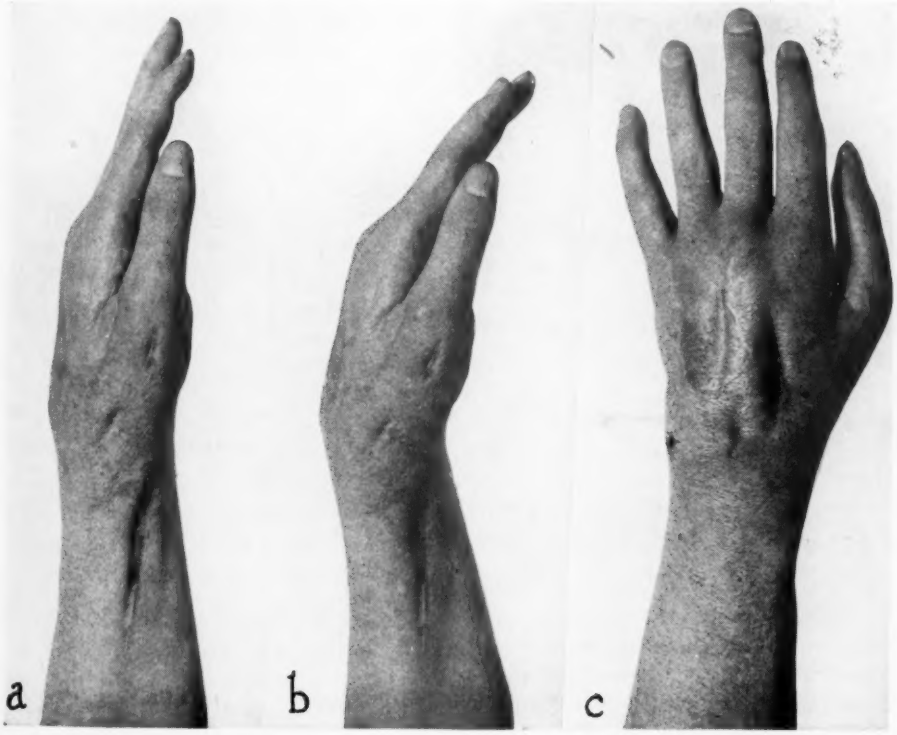


**FIG. 2.—Limits of extension (a), and flexion (b), in the hand and wrist of a fifty-one-year-old physician two and one-half years after an acute spreading infection following a needle prick of the thumb sustained during a surgical operation. (c) Fixation of thumb in adducted position.**

too well known to require a detailed discussion of their several contributions. The papers of Kanavel[13, 14, 15] upon infections of the hand and the treatment of their sequelæ have come to be recognized as outstanding contributions to American surgery. In any discussion of the subject of tendon grafts the pioneer work of Bunnell must be acknowledged at the very beginning. No one has done more to perfect the details of operation nor has obtained more beautiful results than he has shown in his several and excellent papers on the reconstructive surgery of the hand and the surgery of the nerves and tendons of the hand. In our own work we have borrowed freely from each of those mentioned and have tried to adapt the helpful ideas they have suggested to our own particular problems.

FIG. 3.—Typical contracture following an injury of flexor tendons with division of median and ulnar nerves.

### FREEING OF FIBROSED TENDONS

The hand with rigid motionless fingers, often shiny from trophic changes and wasted from disuse, at times almost fixed as though cast in iron, is a familiar object to the surgeon interested in the surgery of the hand.* In such a hand the fingers may be fixed in flexion (Fig. 1), a position identical with that seen in von Volkmann's ischæmic contracture, and there may be in addition a complete ankylosis at the wrist-joint; the fingers may be extended with the thumb extended and lying alongside the palm (Fig. 2); if there is associated median- and ulnar-nerve injury the fingers may be held in semi-flexion at the interphalangeal joints and in hyperextension at the metacarpophalangeal joints. (Fig. 3.) In less seriously injured cases the fibrous-tissue fixation may involve several fingers only, or even a single digit. No matter in what position the fingers have become fixed as a result of the initial injury or infection or how extensive the involvement, these cases have one common characteristic—loss of the ability of the tendons to glide freely through their normal range of move-

* "One sees a glossy skin with atrophied hypothenar, thenar, and forearm muscles and shrunken intermetacarpal spaces, the thumb frequently abducted and fixed, the fingers flexed upon themselves and extended on the hand, with fibrous ankylosis of the finger-joints, and frequently osseous ankylosis at the wrist-joint producing an immobile, shrunken, claw-hand, absolutely functionless and useless. Moreover, owing to the poor nerve and blood supply, the hand is often the seat of ulcers, frost-bites, and inadvertent burns." (Kanavel.[16])

ment.* This may be due to fixation of the tendons in a limited area; it may be due to a fibrosis involving the entire length of the tendons; and in cases of long standing or after a severe spreading infection fibrosis of the muscle bellies, with its resulting limitation of muscle contraction and relaxation, may add an additional handicap to the normal movement of the tendons.

It is obvious that after infection about a tendon or within its sheath, or after the extravasation of serum and blood-cells which follows an injury, the resulting scar-tissue formation is most marked and damaging at the sites of greatest constriction, where the exudate is held under tension in a limited space, and where tendons lie close to one another in definitely limited tunnels or compartments.† These sites are within the digital flexor sheaths and underneath the transverse carpal (anterior annular) ligament on the volar surface of the hand and wrist, and in the various compartments underneath the dorsal carpal ligament on the dorsal surface of the wrist. In certain cases the limiting fibrosis may be confined to one of these areas. In others, in which a pancellulitis of hand and forearm has been present, both flexor and extensor tendons may be bound in scar tissue throughout almost their entire extent. No matter how limited or extensive the scar-tissue formation, improvement of function depends upon the completeness with which the tendons can be freed from its vise-like grip.‡

In certain cases, as suggested above, an additional factor which also affects the movement of the tendons must be considered. If the contracture follows a severe spreading infection in which there has been extensive involvement of muscles as well as tendons, and if the fingers have been kept motionless in extension during the period of acute infection, the flexor muscles become fixed in a relaxed position. If after their tendons have been freed such

* We do not mean to imply that the loss of the ability of the tendons to glide freely is the sole cause of the disability but that it is a constant factor in the types of cases under discussion. The periarticular fibrosis and fibrous contraction of joint capsules which follow infection and long-continued immobilization often constitute another important factor in the disability, but, as stated above, the present discussion is confined to the part played by the involvement of the tendons.

† "The infection has followed the paths of nerves and blood-vessels and the resulting scar contraction has so strangled them that the tissues supplied have become atrophic and congealed. The greatest damage is done in the closed spaces, as under annular ligaments, in the tendon sheaths and in the fascial spaces, where swelling is limited and necrosis, from both ischæmia and infection, results." (Bunnell.[5])

‡ "The first endeavor should be to find the median and ulnar nerves in the forearm and trace them into the palm. . . . The nerves are dissected out of their surrounding tissues well down into the hand, the greatest care being used to avoid cutting any of the branches in the palm. . . . Where blood-vessels are met, especial care is taken to preserve them.

"The tendons as far as possible are dissected out of the mass of connective tissue. It is frequently necessary to use the connective tissue itself as tendons. . . . The tendons are dissected and flaps of fat are inserted, one layer under the tendons, one between the superficial and deep tendons, and one above. . . . The wounds are then closed." (Kanavel.[16])

muscles should regain two-thirds of their former contractile power such a degree of contraction would still be insufficient to draw the fingers into complete flexion, and in such cases it is necessary to shorten the flexor tendons as well as release them from scar tissue. In the same way, if the flexor muscles have remained contracted throughout the duration of an extensive infectious process no amount of stretching which stops short of rupture of muscle fibres is adequate to overcome the flexion contracture even after the tendons have been freed throughout their entire extent, and in such cases the flexor tendons must be lengthened by a tendon lengthening operation or with the aid of a graft.

If tendon lengthening is carried out it is well to remember that the essential movement of the fingers from the standpoint of function is that of flexion. In the last analysis, aside from their normal antagonistic action to the flexor muscles, the extensor tendons serve only to open the hand. If complete restoration of both flexion and extension is impossible it is better to sacrifice a part of the function of extension. In other words, a patient who can extend his fingers incompletely, but sufficiently to put a glove on the hand without undue difficulty, and who can flex them forcefully into the palm has a much more useful hand than the patient who can straighten his fingers completely but cannot flex them into the palm or grasp small objects.

If, then, tenolysis can be satisfactorily accomplished and combined when indicated with shortening or lengthening of the tendons, if after the tendons are freed normal areolar tissue or fat is placed about them to help prevent reformation of adhesions, and if active movement is instituted promptly after operation definite improvement in function can reasonably be anticipated.

A brief account of a few specific cases may help to present the problem in a concrete form.

Case I.—J. H., Passavant Memorial Hospital (8818), December 16–19, 1931. This patient, a boy of four years, had gradually developed a loss of function which consisted in an inability to extend the right thumb beyond an angle of 135° at the interphalangeal joint. If an effort was made to extend the thumb beyond this angle the base of the proximal phalanx was drawn volarward with a resulting volar subluxation at the metacarpophalangeal joint.

One month before admission to the hospital he had fallen to the floor while carrying a bottle in his right hand. The breaking glass caused two small penetrating wounds of the palm, and a third slightly larger wound just lateral to the mid-line of the volar surface of the thumb, a little proximal to the metacarpophalangeal joint. The wounds were covered with clean dressings and healed without infection. It was only after some weeks that the parents noted the disability described above.

December 16, 1931, under ethylene anæsthesia, the scar over the metacarpophalangeal joint of the thumb was excised and the deeper tissues exposed. The digital nerve to the radial side of the thumb was intact; the fascial covering of the flexor pollicis brevis was divided, but the muscle and tendon were intact. The tendon of the flexor pollicis longus was thickened opposite the joint, and firmly adherent to the base of the proximal phalanx of the thumb. Because of this adherence the thumb could not be completely extended at the interphalangeal joint, and when further extension was attempted the tension exerted upon the base of the proximal phalanx drew it volarward into a subluxated position. When the adherent tendon was freed from the bone the thumb could

be extended completely and the tendency to volar subluxation had disappeared. On lifting the completely freed tendon into the wound a spindle-shaped enlargement could be seen at the point where the tendon had been adherent to the bone.

It seemed probable that the patient had sustained a partial division of the tendon at the time of injury, and that during the process of healing the tendon callus, represented by the spindle-shaped enlargement, had become adherent to the base of the proximal phalanx.

When it was evident that there was no other obstacle to the free movement of the tendon a thin layer of subcutaneous fat was laid underneath the tendon, the thin tendon sheath loosely closed with two fine silk sutures and the superficial wound closed. Healing took place by primary union, and when last seen, three weeks after operation, the patient was moving his thumb in a normal manner.

CASE II.—O. F., Passavant Memorial Hospital (1910), February 20–May 24, 1930. This patient, a machinist thirty-two years of age, entered the hospital seven months after sustaining a severe crushing injury of the left hand with an extensive laceration of the palm, a compound fracture of the bones forming the middle metacarpophalangeal joint and a simple fracture of the proximal phalanx of the ring finger. The crushed middle finger was amputated immediately and the lacerated wounds sutured. A very considerable loss of function followed as a result of the injury and the extensive fibrosis which developed during the process of healing, but the feature of the disability of particular interest in connection with this discussion was the inability to extend the ring finger beyond a right angle at the proximal interphalangeal joint.

February 21 the flexor tendons of the ring finger were exposed through an incision on the radial side of the finger and tension put upon the distal phalanx. It was then seen that the flexor profundus had become firmly adherent to the bifurcating sublimis over the proximal phalanx close to the site of fracture. When the two flexor tendons were separated from one another by sharp dissection the finger could be extended with the exercise of very little force to 170°, or almost a straight line.

It seemed probable that the crushing injury of the hand, which was severe enough to produce with other injuries a fracture of the proximal phalanx of the ring finger, had possibly resulted in a partial division of the tendons at the site of injury and had certainly been followed by hæmorrhage into the tendon sheath as well as into the bone, and that as a result of the injury and associated hæmorrhage a fibrosis had developed at a site of constriction, namely the point of bifurcation of the flexor sublimis, with a resulting interference with the free gliding movement of the affected tendons.

During the two months during which this patient remained under observation there was no evidence of recurrence of the contracture of the affected finger.

CASE III.—L. B., Passavant Memorial Hospital (11842), October 3–12, 1932. This patient, a boy of seventeen years, sustained two rather extensive wounds in an automobile accident July 25, 1932, the larger over the dorsolateral aspect of the left wrist, the second over the dorsal surface of the metacarpophalangeal joint. A half hour after the accident the wounds were cleansed and sutured; they healed without infection. Following the injury the patient was unable to extend the fingers of the left hand; the index finger was most seriously involved, the other fingers to a lesser extent. The appearance of the hand, and the degree of extension possible when he came to us in October, 1932, is shown in Fig. 4.

October 4 the oblique scar over the dorsum of the second metacarpophalangeal joint was excised and the adherent extensor tendons of the index finger freed from the overlying skin and underlying bones. There was no interruption in continuity. A thin flap of fat was laid underneath the freed tendons and the skin carefully sutured over them. A second, semilunar incision was made over the dorsum of the left wrist and the tendons exposed. The extensor pollicis longus was seen to lie uninjured in a normal sheath. The extensor digitorum communis was bound by scar tissue to the deep surface of the dorsal carpal ligament and to the floor of the dorsal carpal tunnel. After the tendons were

completely freed a thin pedunculated flap of subcutaneous fat was brought underneath them and held with a single suture. The dorsal carpal ligament was resutured rather loosely and the skin edges accurately apposed. A light splint was applied to relax the fingers by supporting the hand and forearm in dorsal flexion at the wrist.

The operative wounds healed by primary union, and when the patient left the city

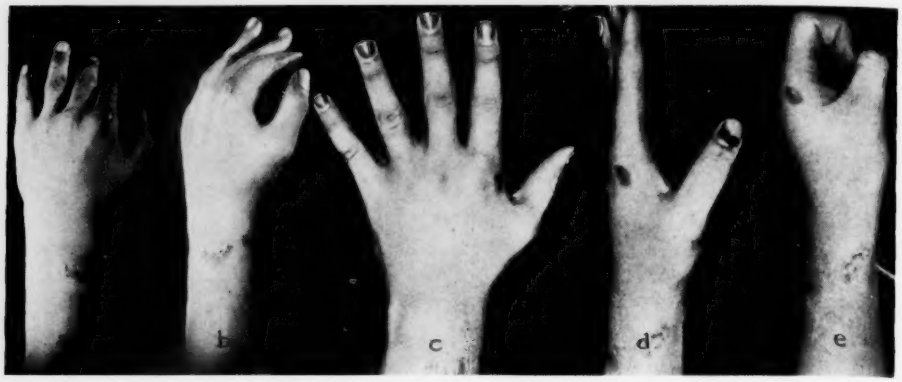


FIG. 4.—(Case III.) Loss of function of extensor tendons due to scar tissue fixation following a cutting, crushing injury. (a), (b) Before operation. (c), (d), (e) Result four weeks after tenolysis.

four weeks after operation he had already regained a considerable degree of function. (Fig. 4, c, d, e.)

CASE IV.—W. F., Wesley Memorial Hospital (115215), October 26–November 18, 1924. This patient, a blacksmith in a far western state, at the age of twenty-four, fourteen years before admission to the hospital, accidentally drove a nail into his right palm. A veterinary surgeon immediately injected turpentine into the hand to prevent the development of infection. The hand, forearm, arm and shoulder became tremendously

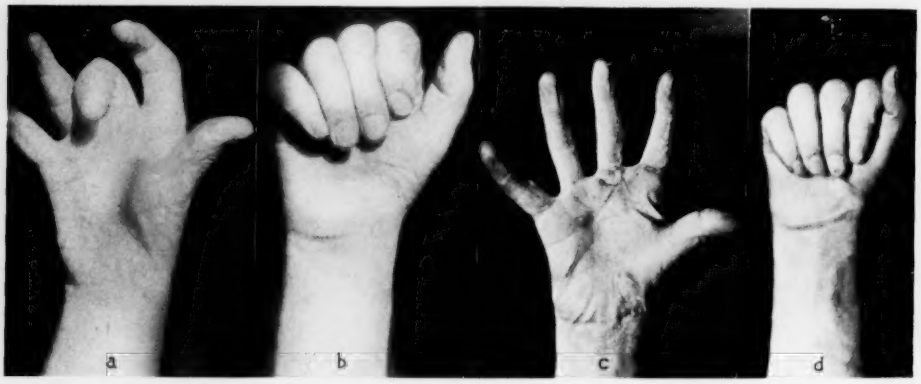


FIG. 5.—(Case IV.) Limitation of movement of fingers due to extensive fibrosis following injection of turpentine into the palm to prevent infection from a puncture wound. (a), (b) Before operation. (c), (d) Five and one-half months after tenolysis of flexor tendons of middle finger. Note the increased range of movement of the three other fingers as well as the finger operated upon.

swollen, the skin of the palm sloughed away, and "large drainage holes were made" in the hand, forearm and arm. The function of the hand and fingers was lost for five months, but with persistent use and effort function gradually returned except for the fact that the middle finger remained flexed at the interphalangeal joints, and could not be extended beyond the position shown in Fig. 5, a.

October 27, 1924, under local anæsthesia with ½ per cent. novocaine, the flexor tendons were carefully exposed through an extensive incision on the radial side of the

finger. From the middle of the middle phalanx as far proximalward as the distal flexion crease of the palm the flexor tendons were fixed by fibrous tissue. After they were completely freed by sharp dissection the finger could be completely extended with the aid of a moderate degree of tension. A pedunculated flap of subcutaneous fat was placed underneath the tendons and the wound closed without drainage.

The operative wound healed by primary union. Five months after operation the patient was able to flex and extend the index, ring and little fingers, the fingers not operated upon, almost completely, and definitely more fully than before operation.* (Fig. 5, c, d.) Extension and flexion of the middle finger was also practically complete.

CASE V.—J. C., Passavant Memorial Hospital (6778), June 9–19, 1931. This patient, an editor forty-five years of age, fell on a broken glass bottle seven months before admission to the hospital, and sustained a severe laceration of the right palm. He noted immediately that the index, middle and ring fingers were numb and that he was unable to move them at the interphalangeal joints. He was operated upon shortly after the accident; the fingers were splinted in extension for three weeks after the operation; the operative wound was healed at the end of six weeks.

On admission to the hospital the patient presented the symptoms of a complete division of both flexor tendons of index, middle and ring fingers and of the digital branches of the median nerve to these fingers. The fingers were held in complete extension, but the joints were fairly flexible and the patient could flex the fingers almost into the palm with the help of the other hand. On exposing the site of injury through a transverse palmar incision parallel with the flexion creases it was found that the tendons and nerves had been completely divided at the level of the middle flexion crease of the palm. The distal segments of the tendons had retracted to the level of the metacarpophalangeal joints, the proximal segments to a line just above the wrist-joint. After the distal segments were isolated and freed at the level of the metacarpophalangeal joints they were grasped with moist gauze in an attempt to draw them down into the operative field. Since this could not be done an incision was made along the radial side of the index finger and the flexor tendons of this finger exposed within the digital sheath. It was then found that the tendons were adherent to the sheath throughout its entire extent, and only when they had been freed by sharp dissection was it possible to draw the finger into flexion by tension upon the free ends of the tendons in the palmar incision. To lessen the likelihood of reformation of adhesions the distal segment of the flexor sublimis was detached from its insertion at the base of the middle phalanx and removed, leaving the deep tendon alone within the digital sheath.† The same procedure was carried out in the middle and ring fingers, and the remaining deep tendon of each finger then united by end-to-end suture to the proximal segments of both its superficial and deep tendons. In other words, in each finger a single distal segment—the deep tendon—was united to the two proximal segments.

Although this is a case of end-to-end suture of divided tendons and nerves, it is included in this group because of the tenolysis of the flexor tendons in the fingers and because it emphasizes the fact that if the flexor tendons have become "frozen" within the digital sheaths as a result of prolonged immobilization or a low-grade infection, or a combination of both, tendon suture or the bridging of the gap between the retracted ends of the divided tendons with grafts cannot be expected to bring about a helpful result. If one cannot draw a finger into flexion by direct traction upon the ends of the flexor

* The improvement of extension in the fingers other than the one operated upon emphasizes the point which Bunnell has stressed, that fixation of the flexor tendons of one finger limits the movement of the remaining flexor tendons, and because of that fact it is unwise when one amputates a finger to suture the stumps of the flexor and extensor tendons to one another over the end of the exposed bone.

† "To obtain more room in the finger the sublimis may be withdrawn and sacrificed, as the loss of its function is hardly noticed." (Bunnell.[3])

tendons exposed in the palm, it is obvious that suture of these ends to the proximal portion of the tendons is a futile procedure.

CASE VI.—T. Z., Passavant Memorial Hospital (12219), November 14–December 11, 1932. This patient, a miner thirty-nine years of age, was first seen in November, 1932. He stated that August 5, 1925, he scratched the palmar surface of the right thumb with a piece of slag. Three days later, August 8, because of swelling and pain, a small incision was made over the palmar surface of the proximal phalanx of the thumb and hot wet dressings applied. August 13 another incision was made; the pain and swelling, however, became more marked and he was admitted to the hospital the same day. Two days later the affected area was opened widely under general anæsthesia by an incision across the thenar eminence.

He remained in the hospital with a draining wound for six weeks; the incisions finally healed in the latter part of October, 1925. While he was in the hospital the fingers gradually became fixed in a flexed position and the thumb flexed into the palm. He returned to work in February, 1926, but little improvement was noted and the condition remained practically unchanged until November, 1932. In spite of the flexion contracture he worked steadily from 1927 to 1929, and intermittently from 1929 to 1932. During the

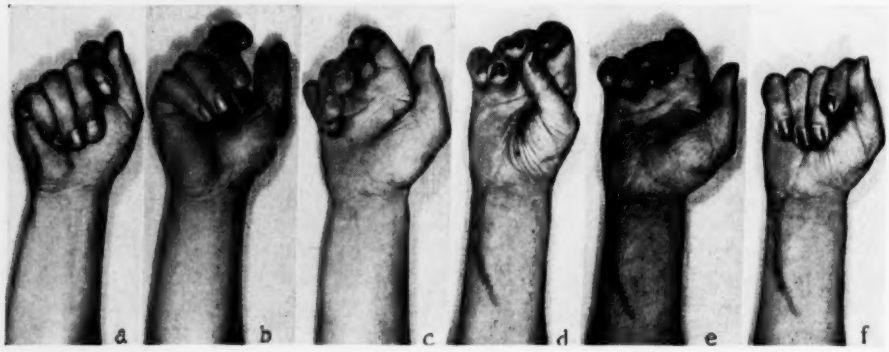


FIG. 6.—(Case VI.) Flexion contracture of fingers and thumb due to spreading infection starting in tendon sheath of thumb. (a), (b), (c) Before operation. (d), (e), (f) Three and one-half weeks after tenolysis of flexor tendons and insertion of graft to replace destroyed portion of flexor tendons of little finger.

latter period the fingers, particularly the fifth, became a little more flexed, and there was some increase in pain, particularly over the original incision and between the fingers.

The position of the fingers and condition of the hand is shown in Fig. 6. The thumb and little finger could not be extended. The index, middle and ring fingers could be extended almost completely when the fingers were completely flexed at the metacarpophalangeal joints.

November 16, 1932, under ethylene anæsthesia, the flexor tendons were exposed in the hand and lower third of the forearm by the incisions indicated in Fig. 7. From a level two inches above the wrist-joint as far distally as the middle flexion crease of the palm—in other words throughout the extent of the common flexor sheath—the flexor tendons were bound together in a mass of fibrous tissue. When they were freed from the floor and walls of the carpal tunnel and from one another the thumb and medial three fingers could be extended fairly well. The little finger, however, could not be extended even after the flexor tendons were freed in the finger as well as in the hand, for they had become contracted to such an extent that complete division was necessary to permit extension. After they were divided and the finger straightened the resulting gap of one and one-half inches was filled with a free graft of palmaris longus. A free graft of fat from the abdominal wall was laid between the flexor tendons and the floor of the carpal tunnel. The wound was carefully closed, but no attempt was made to secure accurate reformation of the anterior annular ligament.

The operative wound healed by primary union. A week after operation a tension splint was applied to help draw the fingers into extension. (Fig. 7, a.) Active physical therapy was begun thirteen days after operation, and continued until the patient left the city four weeks after operation.

In this case a diagnosis of Dupuytren's contraction had been made by the patient's physician, but the history is that of an infection of the tendon sheath of the thumb which subsequently extended into the forearm, involved the common flexor sheath, the ulnar bursa and the digital sheath of the little finger. It was noted above that when the fingers were flexed at the metacarpophalangeal joints the index, middle and ring fingers could be extended; in other words, these fingers were held in flexion by the fixation of their tendons underneath the anterior annular ligament and within the common flexor sheath, but not by adhesions within the digital sheaths. The thumb and little finger, on the other hand, were more markedly involved in the flexion contracture, and the fibrotic process involved the tendons throughout their entire course. It is interesting to note, in passing, how accurately this case exemplifies the course and extent of an infectious process which begins in the tendon sheath of the thumb and spreads along the channels which in the great majority of cases communicate directly with that sheath.

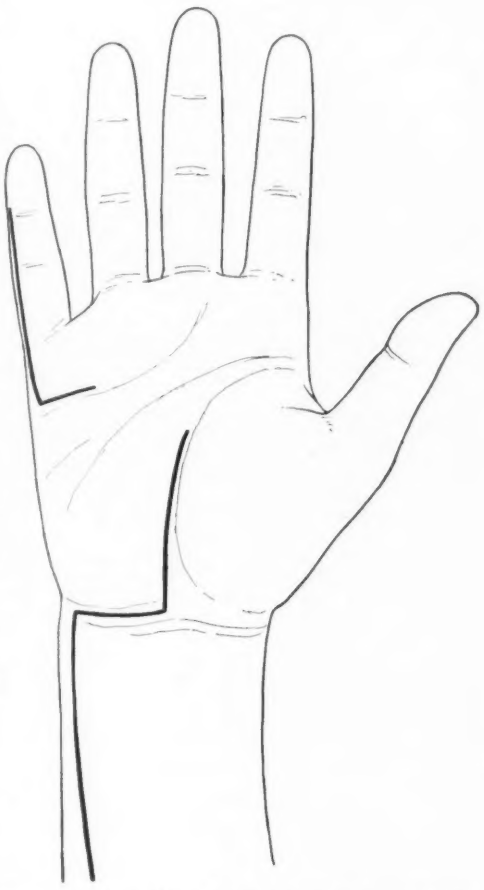

FIG. 7.—(Case VI.) Incisions used to expose field of operation.

CASE VII.—W. B., Wesley Memorial Hospital (108139), September 25–October 9, 1923; (108631), October 22–November 2, 1923. This patient, a salesman of twenty-nine years, sustained a deep, irregular glass cut of the volar surface of the left wrist in an automobile accident July 10, 1923. He was operated upon elsewhere shortly after the accident and the divided tendons sutured. Wound infection developed and delayed healing for some weeks. A complete loss of sensation of the palm was first noticed during the period of wound healing.

The appearance of the hand and the extent of movement present when the patient came to us two and one-half months after the accident is shown in Fig. 8. At operation the sutured superficial flexor tendons and the divided median and ulnar nerves were found bound together in a mass of scar tissue. The proximal segment of the divided

ulnar nerve had become united to the distal segment of the divided tendon of the flexor carpi ulnaris. The divided ends of the median nerve were widely separated. The deep flexor tendons were involved in scar tissue but were intact. The tendons and nerves were carefully separated from one another; the superficial flexor tendons were shortened, the divided flexor carpi ulnaris and the divided ulnar nerve united by end-to-end suture. Because of the considerable gap between the divided ends of the median nerve the neuromata at the divided ends were temporarily united, so as to draw the separated nerve ends into apposition.

FIG. 7.—(a) Splint to bring elastic tension to bear on contracted fingers by means of loops and garter elastic tightened with the aid of small buckles.

Four weeks later, October 23, the operative wound, which had healed by primary union, was reopened, the neuromata excised from the median nerve, and the freshened ends accurately united by end-to-end suture.

The functional result seven years later and the evidence of return of motor function of the median nerve, as indicated by the patient's ability to rotate the thumb so as to face the fingers, are shown in Fig. 8, c, d.

CASE VIII.—L. H., Wesley Memorial Hospital (86446), July 7–20, 1920; (88981), November 4–16, 1920. This patient, a nurse of thirty-one years, was admitted to the hospital in July, 1920, two years after a protracted and serious illness due to an acute and rapidly spreading streptococcic infection of the right hand and forearm which had

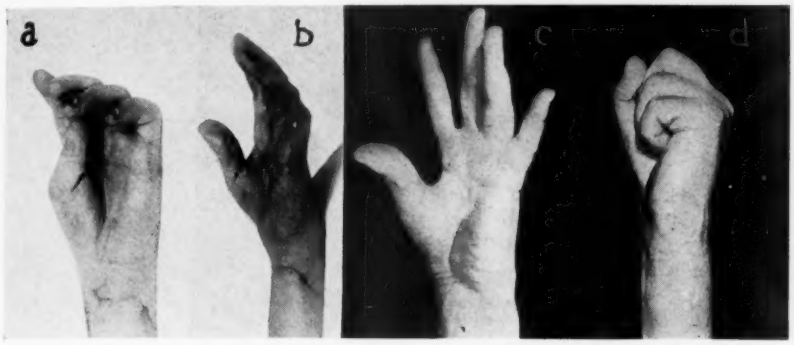


FIG. 8.—(Case VII.) Loss of function of left hand resulting from lacerated wound injury of volar surface of the wrist with division of flexor tendons and median and ulnar nerves. Tendon suture immediately after the injury and apparently without attempt at nerve suture was followed by wound infection. (a), (b) Appearance of hand before secondary operation, two and one-half months after injury. (c), (d) Result two and one-half years after secondary operation.

followed a needle prick of the thumb. It is unnecessary to recount the history she gave of her original illness and of the many and various operative procedures that were carried out during her five months' stay in the hospital. When she came to us there was a complete bony ankylosis at the wrist-joint and a very marked limitation of movement of the fingers and thumb. (Fig. 9.)

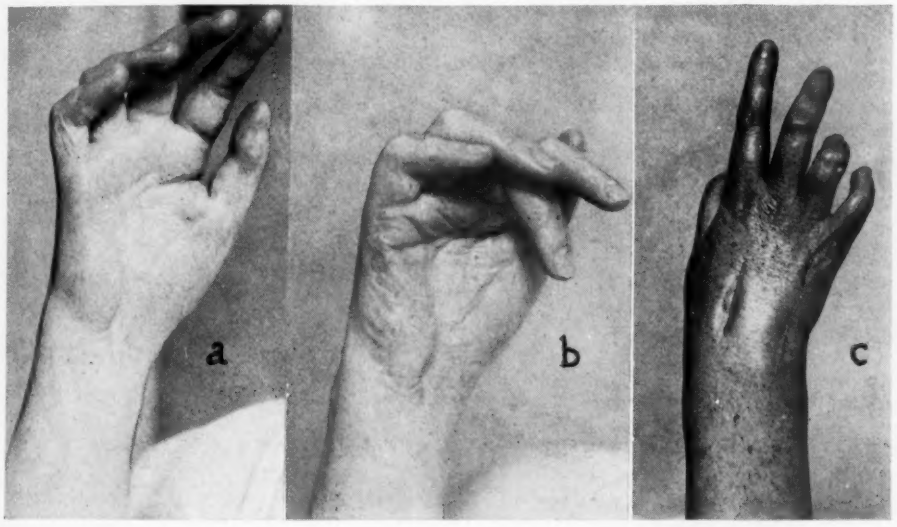


FIG. 9.—(Case VIII.) Severe disability resulting from a streptococcic infection of the hand and forearm following a needle prick of the thumb. (a), (b) Limits of extension and flexion before operation. (c) Healed scars of multiple operative incisions made on dorsum of hand and forearm.

July 8, 1920, an arthroplasty was performed at the wrist-joint and the extensor tendons freed from overlying skin and underlying metacarpus and surrounded by thin transplants of fat. Physical therapy was begun shortly after operation.

November 5, four months after the first operation, the flexor tendons were freed

from the scar tissue which bound them together and fixed them to the surrounding tissues, shortened one-half inch and surrounded by thin fat transplants.

Physical therapy was again instituted shortly after the second operation. Fig. 10

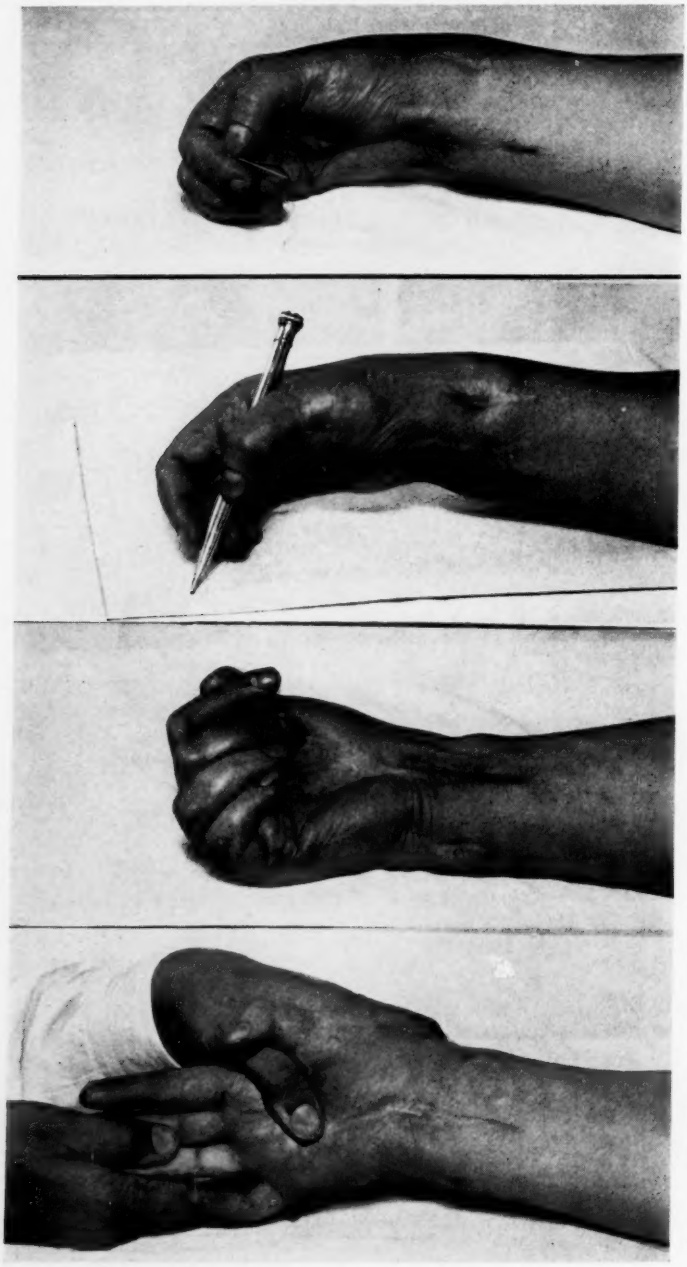

FIG. 10.—(Case VIII.) Restoration of function four months after second operation in a hand which was practically useless as a result of extensive and long-continued infection.

indicates the improvement in function eight months after the first operation, and four months after the second.

It will be noted that these cases have been arranged in the order of their severity—the first and second with involvement of flexor tendons within a

limited area, the third with localized involvement of extensor tendons, the fourth, fifth and sixth with more extensive involvement of flexor tendons, the seventh with extensive involvement of flexor tendons and division of the median and ulnar nerves, and the last with extensive involvement of both flexor and extensor tendons, and with bony ankylosis at the wrist-joint.

The operative procedures employed in each case, without consideration of the associated nerve or joint complications, have consisted essentially in freeing the affected tendons from surrounding scar tissue and from one another by sharp dissection, surrounding them whenever possible with fat from the adjacent tissues or from the abdominal wall,* in some cases (for example, Cases VII and VIII) shortening flexor tendons which had remained fixed for a number of months in a position of complete relaxation, and in a few cases lengthening flexor tendons which had remained fixed in a position of complete contraction (see résumé of cases, p. 568).

In carrying out these operative procedures every attention possible has been paid to the details of surgical technic which have been stressed so often and by many men as of paramount importance.† These are, particularly, delay of any operative procedure until one can be reasonably certain that there are no longer virulent bacteria still living in the deeper tissues, careful preparation of the hand and forearm before operation, asepsis, the use of a bloodless field during operation, incisions which avoid so far as possible cutting across flexion creases, sharp dissection, gentleness in handling tissues, careful hæmostasis, the use of fine needles and fine suture material, accurate wound closure, the use of pressure dressings after operation, and early post-operative mobilization.

### TENDON GRAFTS

The use of grafts to replace a loss of tendon substance comes into consideration particularly in three groups of cases: First, those in which a division of a tendon has remained untreated for so long a time that marked retraction of the proximal segment has taken place, and neither careful dissection nor stretching of the contracted muscle suffices to bring the proximal segment in approximation with the distal segment. Second, those in which tendon suture has been carried out without success and in which because of post-operative oozing of blood and serum, post-operative infection, the use of heavy and irritating suture material, prolonged immobilization after operation or any one of several other causes, the sutured tendons have become so completely fused with the surrounding tissues that any attempt to free them,

* "In those cases in which the infection has been upon the dorsum of the hand alone, incisions may be made to either side of the interwoven dorsal tendons, and a thin flap of fat inserted between the tendons and the bone and between the tendons and the skin. This flap of fat should not be too thick, since it would then be difficult to close the skin wound. If the technic is properly carried out, such adhesions can be almost entirely eradicated and a practically complete function restored." (Kanavel.[16])

† "It is wise to draw attention to the necessity of the most scrupulous care in our technic, since such long and tedious dissection in tissue of low vitality is especially favorable to the development of infection." (Kanavel.[16])

with the expectation of maintaining freedom of movement afterward, is simply wasted effort. Third, those in which, because of infection or injury, an extensive destruction of tendon tissue has taken place and resulted in a loss which can be compensated for only by replacing the destroyed tendons either with adjacent tendons which can be spared without loss of function or with tendons from the foot.* This last group includes neglected cases of tuberculous tenosynovitis in which conservative treatment has been continued until actual erosion and destruction of tendons themselves has taken place.

In the use of such grafts a number of technical considerations are of importance. The preparation of a suitable bed for the graft, the technic of uniting it with the tendon, the method of attaching it to the distal phalanx if the graft is to replace the tendons of a finger or thumb, the construction of a gliding mechanism about the graft, the formation of new annular ligaments to hold it in place, the tension at which it should be sutured and the degree of relaxation which should be maintained after operation are all of importance in securing a satisfactory result.

*Preparation of a Bed for the Tendon Graft.*—Various methods have been described for preparing a bed for the tendon graft within the finger, and we are considering the finger first because it offers the greatest difficulties. Even after extensive infection within a finger with destruction of tendon tissue a part of the tendon usually remains firmly fused with the surrounding tissues. The first step in preparing a bed for the graft is the removal of this fibrosed tendon. To accomplish this Bunnell has used a modified cork borer with a sharp cutting edge to be applied with a rotary movement. After the freed tendon is removed the graft is drawn through the newly formed tunnel with an elongated flexible carrier. Auchincloss has used small narrow-bladed hæmostats, with the outer surface of the two blades sharpened like a knife, in order to form a tunnel into which the graft can be inserted. Other surgeons have used various methods of blunt dissection to form a bed for the graft. These methods have not proved successful in our hands, partly because of lack of technical ability, but to a certain extent we believe because they do not permit a sufficiently complete removal of the scar tissue which has replaced the normal tendon and tendon sheath, or in the event that the tendon has not been lost, which has surrounded the tendon and bound it to the tissues about it.

It has always been a matter of surprise to us in dissecting in a finger from which the flexor tendons have sloughed as a result of infection, or in which an unsuccessful tendon suture had been done, how dense the scar tissue has become, how firmly any remains of tendon have fused with underlying bone and overlying fascia, and, in the event that the tendons have been lost, how little evidence of a tubular sheath is left behind. If in such cases we have

* "Grafts are easily obtained from the sublimis tendon, the palmaris longus, the long extensors of the toes. . . . If the palmaris longus tendon plus its paratenon is used, it will be necessary to make a longitudinal incision the full length of the graft. A long extensor tendon of the toes plus its paratenon in the dorsum of the foot can be taken without getting toe-drop as the extensor brevis digitorum will serve to extend the toes." (Bunnell.[4])

attempted to free the remains of a tendon with a cork borer by working distalward in a finger from an incision in the palm we have always been disturbed by the amount of force necessary to propel even such a sharp cutting instrument along the path of the tendon. At times we have supplemented this instrument by a small, narrow-bladed knife with a long narrow handle, and still have been confronted with serious mechanical difficulty in attempting to free the tendinous cord of scar tissue within its limited space, a space which is frequently curved in its long axis because of the semiflexed position of the finger. Simple mechanical difficulty is not a sufficient reason for giving up a sound surgical procedure, but we have abandoned this procedure because in

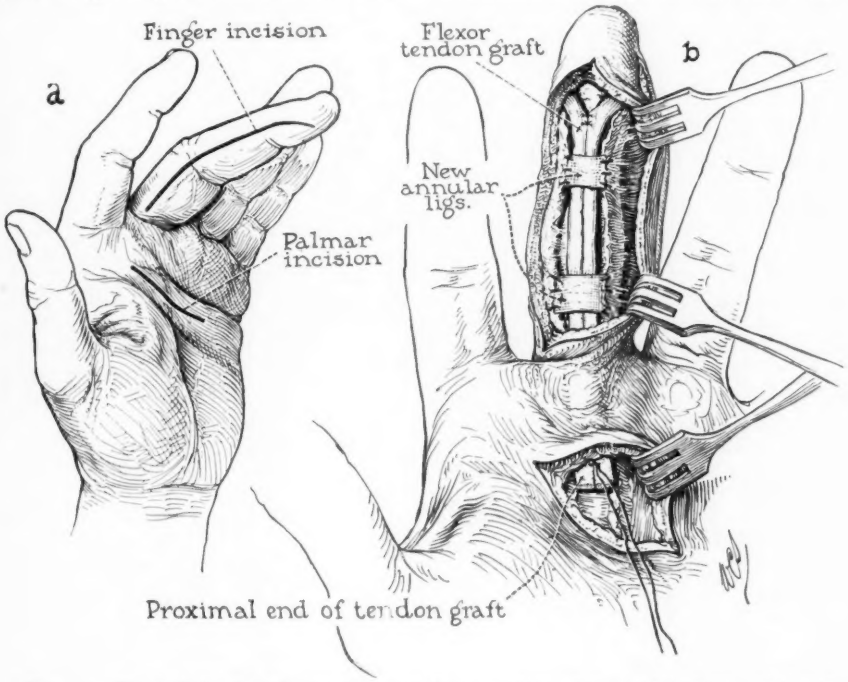


FIG. 11.—The technic of replacing destroyed flexor tendons of the middle finger with tendon grafts. (a) The incisions of choice. (b) Grafted tendons held in place by newly formed annular ligaments.

our hands it necessitated undue trauma, with subsequent post-operative pain, induration and delay in healing; because it did not permit adequate removal of scar tissue and so jeopardized the functional result; and because we were always fearful of injuring digital nerves or blood-vessels which might have been displaced from their normal course by reason of scar tissue contraction or as a result of a previous operative procedure.

Instead, therefore, of preparing a bed for the tendon graft in the finger by one of the methods suggested above we have finally come to depend upon a careful excision of scarred tendon and remains of tendon sheath through an adequate incision made well to the side of the finger (Fig. 11, a) which avoids the flexion creases and so lessens the likelihood of formation of a contracting scar. Such an incision can be supplemented by a transverse extension from its distal end toward the opposite side of the finger; and should end

proximally close to the level of the web. The palmar dissection is carried out through an incision parallel with the flexion creases of the palm.

*Suture of the Graft to the Tendon.*—A careful end-to-end union of the graft to the tendon is the method of choice. To be exact, we prefer to use the method (Fig. 12, b–h) which has been particularly well described by Max Lange[20] and which has the important advantage, as shown by the experimental studies of Mason and Shearon,[24] of leaving practically free from any irritating effect of suture material that portion of the tendon where proliferation of tendon tissue must go on unimpeded if sound union is to take place. If both flexor sublimis and profundus are present and freely movable in the palm the sublimis may be cut off at a little higher level than the pro-

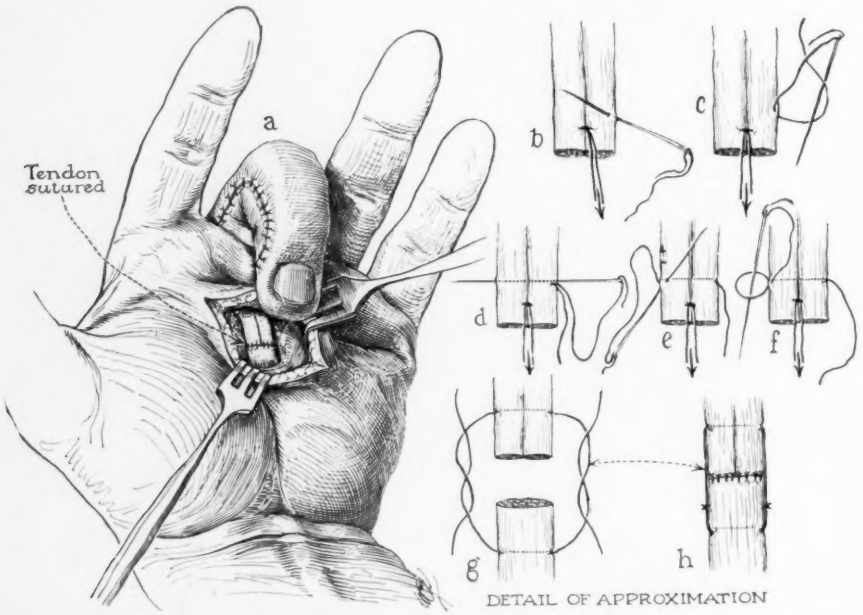


FIG. 12.—The technic of replacing flexor tendons of the middle finger with tendon grafts. (a) Suture of the finger incisions is completed after the grafted tendons have been laid in place. The proximal end of the grafts is sutured to the distal end of the intact tendon in the palm after the finger incisions are closed. (The degree of flexion of the affected finger is exaggerated in the illustration. The sum of the angles of flexion at the metacarpophalangeal and interphalangeal joints should be about 90°.) (b-h) Technic of end-to-end tendon suture. While the graft is being sutured to the tendon in the palm relaxation of both is accomplished by flexing the finger sharply to relax the graft, and by flexing the hand at the wrist to relax the proximal segment.

fundus and the graft united end-to-end with the sublimis, and by a few lateral sutures to the slightly longer underlying profundus over which the proximal end of the graft is laid. (Fig. 17, a.)

If the graft is to fill a defect between the end of a flexor tendon in the palm and its insertion on the distal phalanx of the finger it is important that before it is sutured to the graft the tendon in the palm should be carefully freed from the areolar and fibrous tissue which tends to immobilize it. The divided tendon in the palm is usually recognized by a slight yellowish discoloration at the cut end, seen through a transparent covering of areolar tissue. When this cut end is drawn down with some tension into the operative field the tendon and areolar tissue take on the appearance of an umbrella which

has been turned inside out by a gust of wind, the tendon being the handle and the areolar tissue the everted ribs and silk of the umbrella. Unless this areolar and fibrous tissue is cut away from the tendon by sharp dissection movement will be impeded and the result unsatisfactory.

*Method of Attaching the Graft to the Distal Phalanx.*—Although it requires additional time to attach the graft to the distal phalanx and the procedure is somewhat difficult to carry out, experience has shown that it is wiser to excise the remains of a short stump of flexor tendon still attached to the distal phalanx and attach the graft itself directly to the distal phalanx than to suture the graft within the finger to a short fragment of remaining

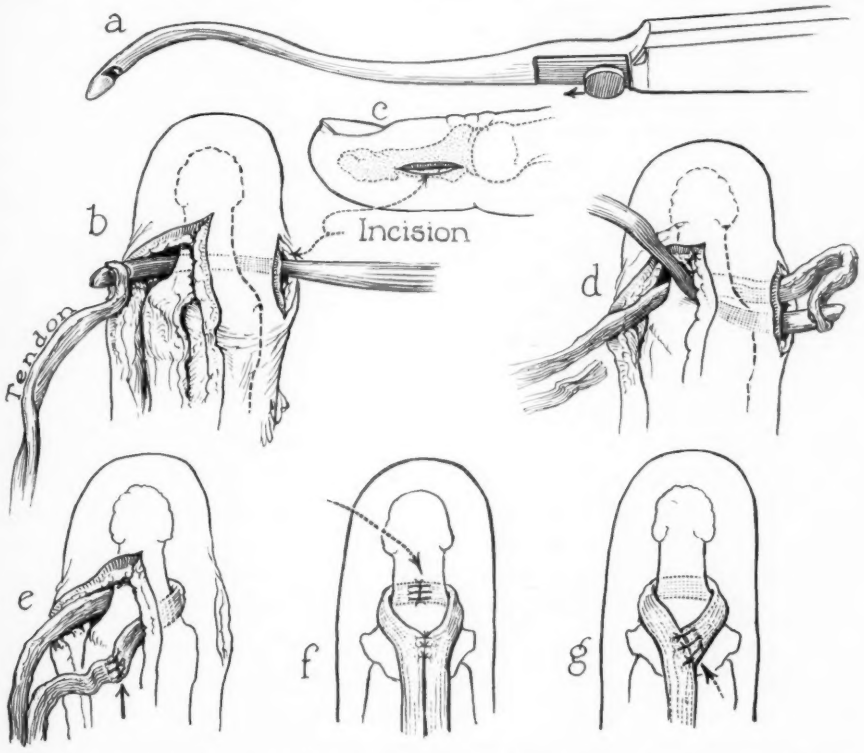


FIG. 13.—The technic of replacing flexor tendons of the middle finger with tendon grafts. Method of attaching tendon graft to the distal phalanx. (a) Reverdin needle modified to serve as tendon carrier. (b-f) Method of attaching tendon graft when two tendons are used. (g) Method of attaching graft when a single tendon is used.

flexor profundus. To attach the graft directly to the distal phalanx Bunnell has suggested boring a small hole through the bone, passing the end of the graft through the drill hole to the dorsum of the finger and suturing it to the periosteum and fibres of insertion of the extensor tendon. We have used this method successfully but if the graft is taken from the foot and two tendons can be spared for one finger we have found the method shown in Fig. 13 of advantage, for, as a rule, the extensor tendons of the foot are slender and narrow, and two of them scarcely equal in mass a single flexor tendon to a finger. If a single tendon suffices the distal end of the graft can be passed

around the base of the distal phalanx and sutured to the graft on the volar surface by an end to side union. (Fig. 13, g.)

*The Construction of a Gliding Mechanism about the Graft.*—This problem offers one of the most difficult of the several involved in the use of tendon grafts. Various ingenious methods of surrounding a graft with a thin layer of fat and inserting the graft and its sheath within the finger have been described and pictured. As a matter of fact, they can be pictured more readily than they can be carried out. To draw a graft surrounded by a newly formed sheath of areolar tissue or fat through a subcutaneous tunnel, we have found very difficult. When we have tried it the sheath usually slipped away from the graft and was left curled up close to the point of insertion. The method of surrounding graft and sheath with a rubber tube before introducing it into the finger we have not attempted for we have rarely found it possible to construct a tunnel large enough to contain a graft, sheath and rubber tube combined. We have, therefore, contented ourselves with removing tendons from the foot with every care to leave attached to them the areolar or gliding tissue which normally surrounds them, and laying the tendons surrounded by this tissue in their bed. In procuring tendons from the foot we have sometimes found it of advantage just after dividing one end of the tendon in the foot to tie a catgut suture about tendon and areolar tissue so as to prevent drawing the tendon away from its covering tissue as it is dissected away from its site in the foot. The fact that we no longer attempt to form subcutaneous tunnels by blind dissection through relatively small openings in palm and finger makes the problem of retaining the gliding tissue about the tendon graft less difficult. In cases in which a part of the superficial flexor of the finger or of the palmaris longus is used for a graft we have sometimes laid a thin free graft of fat from the abdominal wall or from the subcutaneous gliding tissue over the triceps tendon* underneath the graft to prevent it from becoming adherent to the underlying bone. There are two important facts, however, to remember in connection with the construction of a gliding mechanism about a graft: the first, emphasized particularly by Mason and Shearon in the report of their experimental studies on tendon repair, is that the tendon graft must develop a blood supply promptly if it is to survive, and the formation of this blood supply from the soft tissues surrounding the graft may be hindered or even made impossible if a thick layer of areolar tissue or fat is placed between the tendon graft and the surrounding connective tissue. The second is that there is present within the finger only a

* "If the paratenon is not removed intact with the tendon graft, paratenon fat may be gathered from elsewhere and planted sleeve-like about the tendon graft or other tendon to be mobilized. The fat over the triceps tendon is well suited for this purpose. Paratenon fat is specialized fat and differs much from the tough, short-fibred, subcutaneous fat. It is elastic and pliable and can easily be drawn a long distance back and forth from its moorings, as can be seen by comparing the mobility of the skin over the triceps tendon with that over the outer side of the arm." (Bunnell.[4])

limited space for the insertion of graft and covering tissue, a space which is often smaller than that present in the normal finger because of the atrophy and destruction of tissue which have followed the original injury or infection. If one attempts to crowd too much tissue into this space, accurate approximation of the subcutaneous tissue and skin without bulging of soft tissue between the sutures becomes impossible, and since this accurate approximation of wound edges is an important safeguard against post-operative infection from without we feel that it must be secured.

Outside of the finger—in the palm and wrist, for example—we have come to believe that no especial effort to provide a separate sheath for a graft of normal tendon is necessary. We have been strengthened in this belief by the excellent results that have been obtained in cases of tuberculous tenosynovitis in which the parietal layer of the tendon sheath of the flexor tendons has been completely excised in forearm and palm and the tendons left bare in the carpal tunnel, with no tissue intervening between them and its walls. In such cases, if the visceral layer of the tendon sheath has not been involved in the inflammatory process, but has been left bright and glistening, complete restoration of flexion and extension has taken place.

*The Formation of New Annular Ligaments.*—The necessity of providing a substitute for the destroyed fibrous tendon sheath which holds the flexor tendon in contact with the finger and prevents it from standing out like a bowstring as the finger is drawn into flexion is as apparent as the necessity for having a tendon which can glide freely in its bed. Only in rare instances can the remains of the original fibrous flexor sheath be used for this purpose. Bunnell has constructed new annular ligaments by encircling the finger with a tendon graft which is passed between the bone and the extensor tendon on the dorsal surface of the finger; the free ends of the graft are united at one side of the finger, so that the line of suture of the newly formed annular ligament does not lie directly over the newly formed flexor tendon. Auchincloss has used both the slips of insertion of the flexor sublimis and fascial strips to form new annual ligaments.*

We have used both of these methods, and have also laid free grafts of tendinous tissue transversely across the newly formed flexor tendon and attached them on each side to the remains of the fibrous flexor sheath with a few sutures of fine silk. (Fig. 11, b.) In using the latter method we have sometimes taken a longer strip of tendon than was necessary and after suturing it in place as suggested, folded it upon itself at a slight angle and laid it back across the tendon at a slightly higher level. In this way a broader retaining ligament has been obtained. In any event, we have thought it wise when possible to provide an annular ligament opposite the middle phalanx

"* One of the great difficulties is to provide phalangeal annular ligaments, where they have been destroyed, so as to prevent tendon prolapse. If the flexor sublimis tendon has its dividing slips along the side available it is possible to use these. If not, it may be necessary to transplant fascia." (Auchincloss.[2])

and opposite the middle of the proximal phalanx to hold the graft in apposition with the finger during the movements of flexion.

In order to make as easy as possible the procedure of attaching the tendon graft to the distal phalanx, and of constructing new annular ligaments to hold it in its bed when tension is put upon it, we have come to perform these various steps of the operation in a definite order. After the remains of the scarred tendon have been completely excised, the graft is laid in place, and attached to the distal phalanx, preferably by the method illustrated in Fig. 13. A silk suture is attached to the free end of the graft, passed through the tunnel left by the excision of the scar tissue over the proximal portion of the proximal phalanx, and out through the palmar incision. With the graft laid smoothly in the finger and held there by slight tension on its free end the new

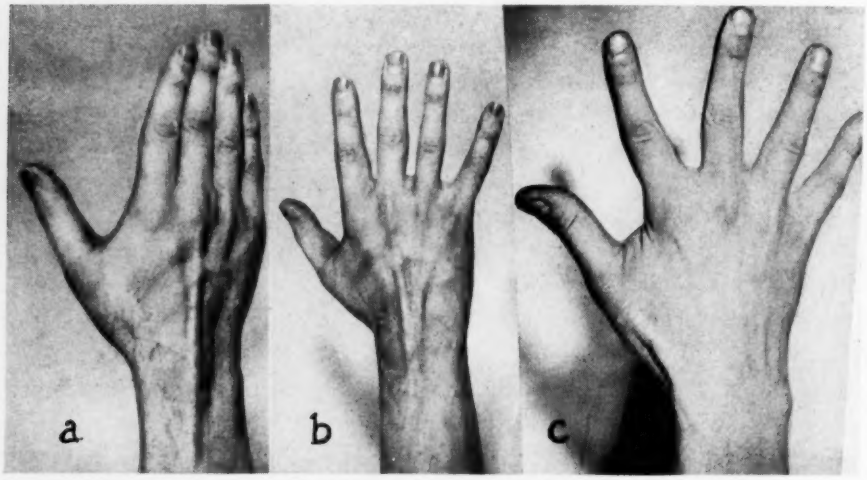


FIG. 14.—Use of tendon graft to replace a portion of the extensor pollicis longus destroyed as a result of a tuberculous tenosynovitis. (a), (b) Before excision of tuberculous tendon sheath and involved portion of tendon. (c) Result one year after operation.

annular ligaments are constructed as described above. When they are completed it is possible by putting tension on the proximal end of the graft to see exactly how well they function, and if they have been sutured under the proper degree of tension.

The next step is closure of the incisions in the finger with the aid of fine silk in the subcutaneous tissues and a fine skin suture. The finger incisions can be closed easily and accurately when the finger is extended, but only with difficulty if the suture of the graft to the tendon in the palm has been completed and the finger drawn down into semiflexion. After the finger incisions have been closed the proximal end of the graft is sutured to the distal end of the tendon in the palm. The graft itself is relaxed by flexing the finger. The tendon in the palm is relaxed by a suture inserted an inch proximal to its free end and used as a guy rope to draw the tendon into the palmar incision

while it is being carefully united to the graft. The final step is closure of the incision in the palm.

*The Optimum Degree of Tension for the Graft.*—The optimum degree of tension at which the graft should be sutured to the tendon and which should be present during the first few weeks after operation while the graft is becoming united to the tendon has not yet been determined.* During the operation and immediately after, excessive tension on a graft on the volar surface of the hand or forearm is avoided by moderate flexion at the metacarpophalangeal joints and more marked flexion at the wrist. This position is maintained after operation by the use of a light aluminum splint on the dorsum of the hand and forearm. In the same way excessive tension on grafts on the dorsal surface of the hand and forearm is eliminated by a volar splint which holds the fingers almost completely extended and the wrist in dorsal flexion. It is our belief that the relaxation obtained by splinting should be sufficient to avoid anything greater than slight tension upon the tendons at the line of suture when the hand is at rest, but that there should still be enough tension so that contraction of the affected muscles can produce a pull on the tendon grafts and movement of the affected fingers.

Early movement, not forceful or long-continued, but carried out at the time of daily dressing, seems to us an important factor in preventing formation of adhesions about tendon grafts and providing the normal physiological conditions for healing and growth.

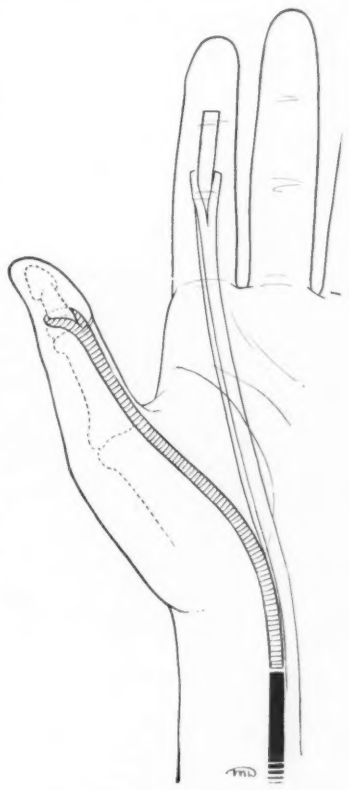

FIG. 15.—Use of tendon graft to replace flexor pollicis longus divided at the level of the metacarpophalangeal joint three months before. The proximal segment had retracted upward above the level of the wrist. (a) Diagram of operative procedure; the graft is indicated by the portion of the tendon with transverse lines.

RÉSUMÉ OF CASES OF TENOLYSIS AND TENDON GRAFTS

During a period of seventeen years, from May 1, 1916, to May 1, 1933, we have had the opportunity of treating 101 cases

*"Muscle and tendon have a definite length, happily termed by Stoffel their physiological length. This length can vary within the range of the normal motion of the joints bridged by the muscle and tendon. If an abnormal position of the joints is assumed as, for instance, in the case of the dog, flexion of the knee and extension of the foot, tendon and muscle are unable to accommodate themselves to this unusual demand.

"*The practical application of these laws is simple.* To restore the normal tension the operator need only approximate origin and insertion of the muscle and tendon in question and suture the tendon to its new position without any tension whatsoever. For

of complicated contracture of the hand by tenolysis, or the use of tendon grafts, or a combination of the two methods. Through the courtesy of Drs. Allen B. Kanavel and Michael L. Mason I have been permitted to include in this résumé fifty-eight cases from the joint service of Doctors Kanavel, Mason and myself at Wesley Memorial Hospital and one case operated upon by Doctor Mason at St. Luke's Hospital, in addition to forty cases from the service of Doctor Mason and myself at Passavant Memorial Hospital and two cases from my service at the Cook County Hospital.

In thirty-nine of these 101 cases tenolysis alone was carried out; in ten, tenolysis with tendon shortening; in three, tenolysis with simple tendon lengthening. Of the fifty-two cases in which tenolysis was carried out, all

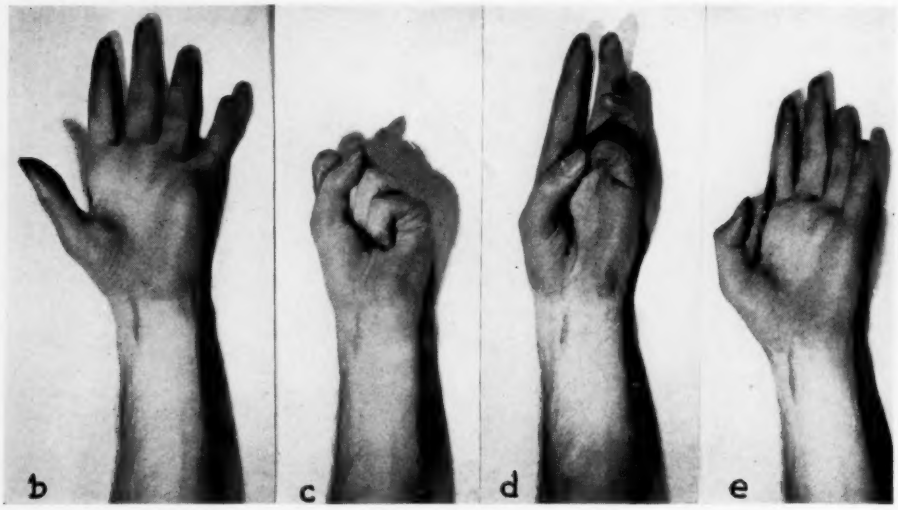


FIG. 15.—(b), (c), (d), (e) Result six months after operation.

of the flexor tendons of fingers and thumb were involved in nineteen cases. In three of the nineteen cases an extensive involvement of extensor tendons was present as well, and tenolysis of these tendons was carried out at a second operation. In thirty-nine of the 101 cases grafts were used and the tenolysis was confined to the tendons in which the loss of substance necessitated the use of a graft, in ten cases an extensive operation to free fibrosed tendons or remove inflammatory tissue was combined with the use of tendon grafts.

instance, in transplanting the peroneal tendon for the paralyzed tibialis anticus, the foot should be held in the position of calcaneovarus and the peroneal tendon sutured to its new point of insertion with just sufficient tension to render it taut." (Mayer.[25])

There are, however, at least two additional factors which must be taken into consideration: the degree of fibrosis which has taken place in the muscle itself, with its resulting loss of both relaxation and contractility, and the extent of separation which takes place at the lines of suture, a factor which Mason and Shearon have found to be constantly present no matter at what degree of tension the tendons are sutured, nor what method of end-to-end union has been used.

The last group included two cases of extensive tuberculous tenosynovitis which had gone on to tendon destruction.*

Of the forty-nine cases in which grafts were used one digit alone was involved in thirty-seven cases (Figs. 14 to 17); two digits in six cases; three digits in one case; four digits, the extensor tendons of the four lateral fingers, in one case; and five digits, the flexor tendons of all the fingers, in four cases. (Fig. 18.) Of the thirty-seven cases in which a single digit was involved grafts were used to replace the flexor tendon of the thumb in six cases, the flexor tendons of the index in ten cases, the flexor tendons of the middle finger in six cases, the flexor tendons of the ring finger in two cases, the flexor

FIG. 16.—Use of tendon graft to replace flexor tendons destroyed as a result of a suppurative tenosynovitis. (a) Diagram of operative procedure; the graft is indicated by the portion of the tendon with transverse lines.

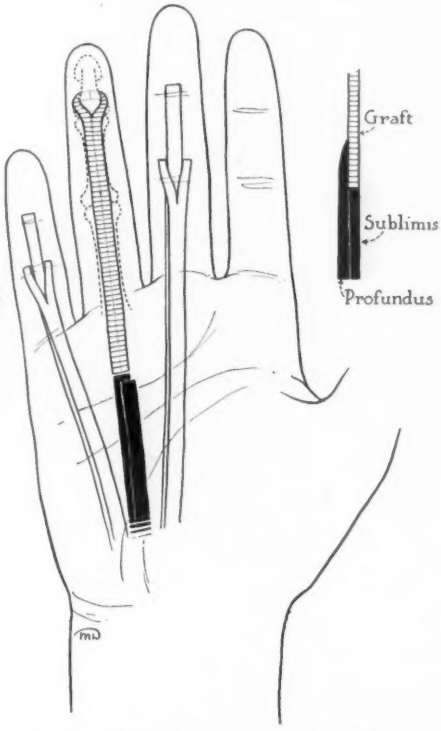


FIG. 17.—Use of graft to replace flexor tendons of ring finger following division eleven months before and two unsuccessful attempts at tendon suture. (a) Diagram of operative procedure; the graft is indicated by the portion of the tendon with transverse lines.

tendons of the little finger in eight cases, the extensor tendons of the thumb in two cases, the extensor tendons of the index in two cases and the extensor tendon of the ring finger in one case.

In eighteen of the 101 cases the operation was preceded by and in five cases combined with the application of a pedunculated flap. In twenty-three cases a division of the collateral ligaments of the metacarpophalangeal or interphalangeal joints or an arthroplasty at one or more metacarpophalangeal or

* Only the cases of tuberculous tenosynovitis in which the destruction of tendons necessitated the use of tendon grafts are included in this series.

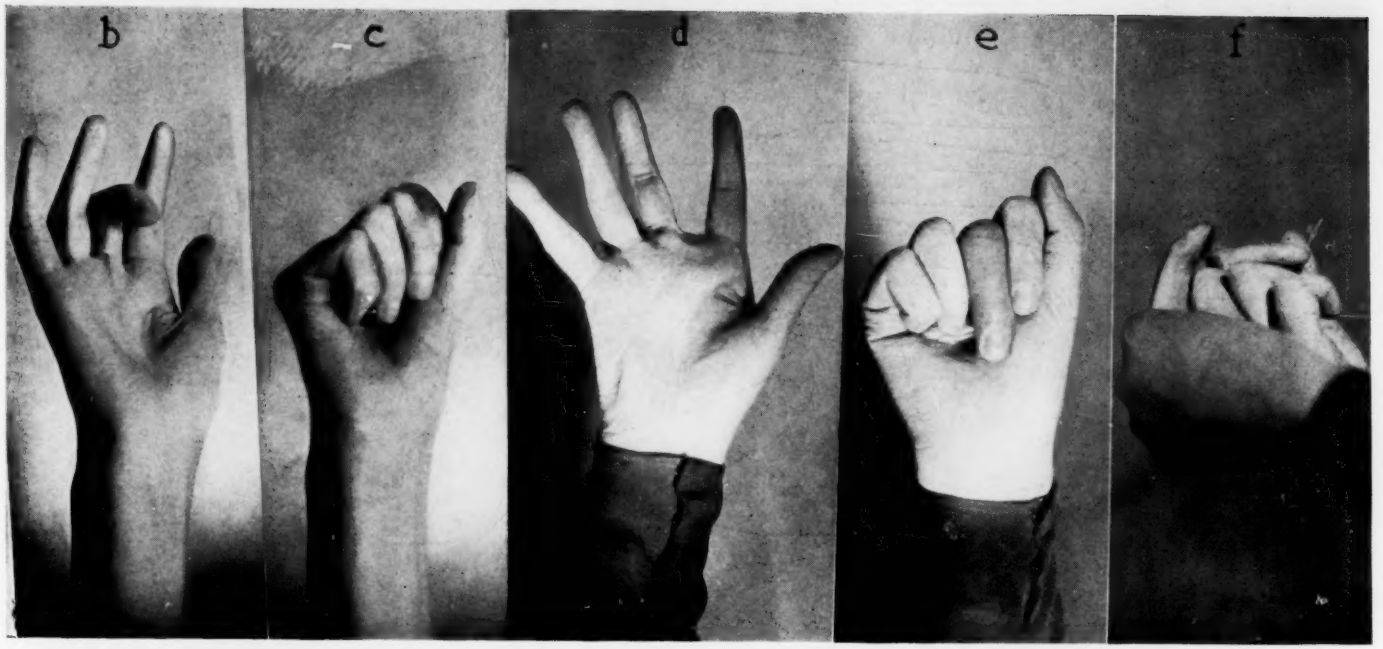


FIG. 16.—(b), (c) Appearance of hand before operation. (d), (e), (f) Result nine months after operation, with restoration of ability to flex the finger at the distal interphalangeal joint. This result would not have been possible if a median longitudinal incision had been made to drain the tendon sheath at the time of the acute infectious process.

interphalangeal joints was carried out before or at the same time as the tendon operation. In four cases an arthroplasty at the wrist-joint preceded the

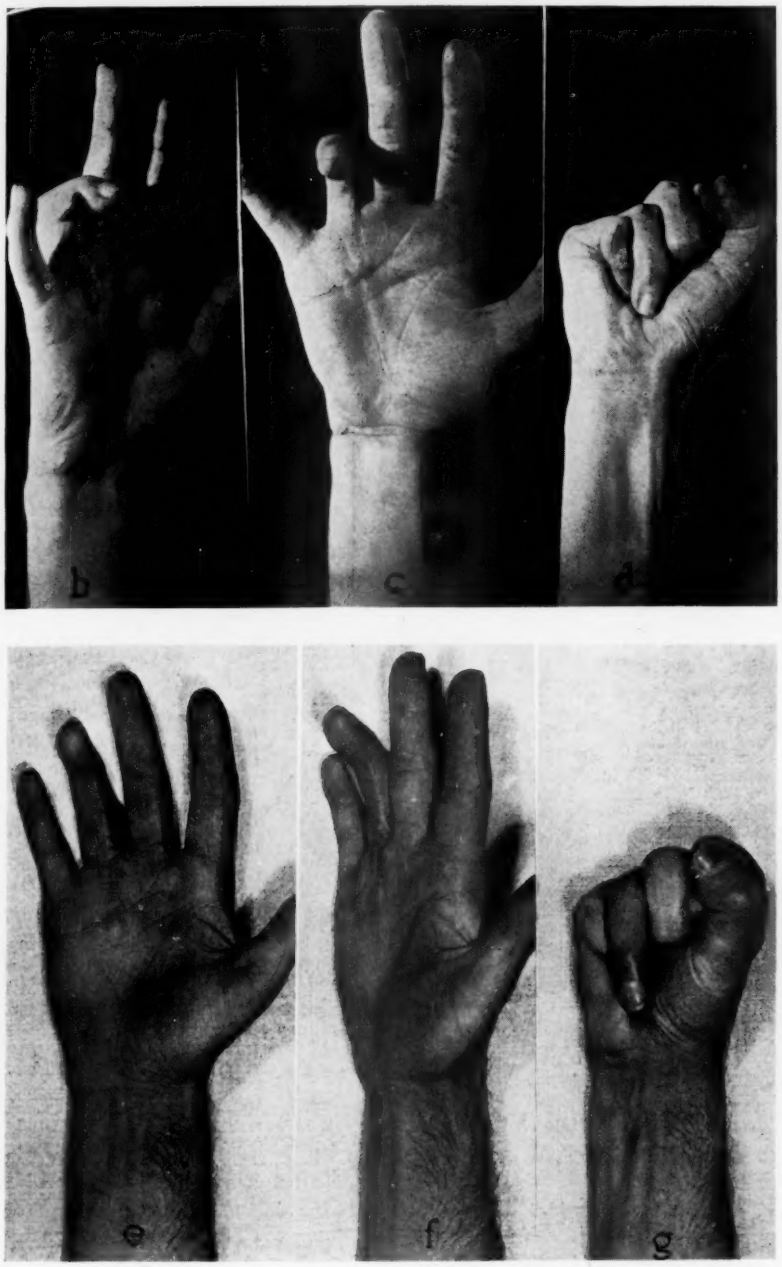


FIG. 17.—(b), (c), (d) Appearance of hand before operation. (e), (f), (g) Result five months after operation.

tendon operation. In nine cases suture of the median or ulnar nerve, in four cases suture of both median and ulnar nerves, and in eight cases suture

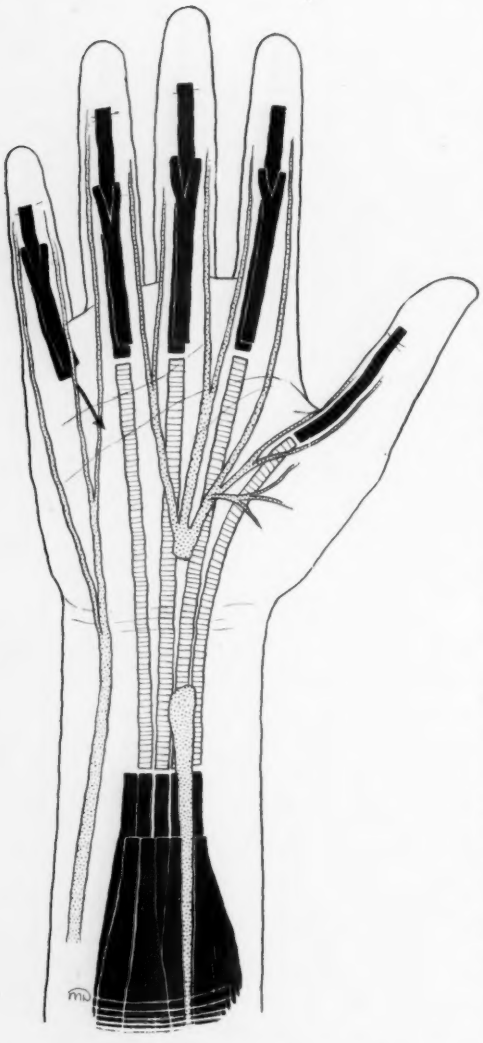

FIG. 18.—Use of tendon grafts to replace flexor tendons destroyed as a result of a long-continued streptococcic infection of the hand and forearm, and protracted drainage with a rubber tube inserted through a palmar incision and emerging in the forearm. Diagram of operative procedure; the grafts are indicated by the portions of the tendons with transverse lines. In this case tendon grafting was preceded by arthroplasty at the wrist-joint and suture of the divided and eroded median nerve.

of one or more digital nerves was performed simultaneously with the tendon operation. In twelve cases more than one of the above procedures—for example, the application of a pedunculated flap and suture of the divided median nerve—were carried out in addition to the tendon operation. These procedures are mentioned simply to emphasize the fact that these cases are truly complicated cases and that several operations have frequently been necesary to secure a satisfactory result.*

The original causes of the disability in the 101 cases cited were fairly well divided between infection and injury. In thirty-seven cases, and these included the majority of cases of practically complete disability, the contracture was due to an acute and rapidly spreading infection which followed a comparatively trivial injury; in fifty-four cases the contracture followed an extensive injury; in seven cases it followed a severe burn. In two cases tendon destruction was due to a tuberculous tenosynovitis; in one to a fibrosarcoma.

Seventy-seven of the patients were males, twenty-four females. Their ages varied from two years to seventy-two years, although only two patients were past the age of forty-seven. The youngest patient was a girl of two years, the oldest

* "The amount of work one can accomplish in a hand in one operation is limited by the time it is safe to maintain ischæmia. Dissection of the hand is so dangerous and difficult when the blood is flowing that all of that part of the work including nerve suture, repair of pulleys, tendon sheaths, and tendons is best completed before the tourniquet is released. As the time necessary to accomplish this in cases where several tendon grafts and nerve sutures are to be done is surprisingly long, it is compulsory to work rapidly. Even then several operations may be necessary to repair a badly damaged hand." (Bunnell.[5])

a man of seventy-two. Five patients were in the first decade of life, fifteen in the second, thirty-four in the third, twenty-seven in the fourth, eighteen in the fifth, one in the sixth and one in the eighth.

The duration of hospital stay varied from one to ninety-three days, the average period was 18.4 days, an average duration of hospital stay increased considerably by the twenty-three cases in whom the application of a pedunculated flap formed a necessary part of the treatment. The average period during which physical therapy was carried out in fifty-one recent cases was 96 days, the average number of treatments forty-five. In the remaining cases we do not have an exact record of the period during which physical therapy was given.

*Results.*—If results of surgical procedures are difficult to evaluate they are particularly so in the types of cases under discussion. Perfect results and restitution to a normal condition after serious injuries or infections involving the hand are ideals impossible of attainment. On the other hand, surgical procedures which bring about a restoration of usefulness in one or more stiff fingers and eliminate the necessity of their amputation and which, in more serious cases, lead to a restoration of function sufficient to enable the patient to return to his former occupation are worthy of serious consideration.

The results obtained in some of the cases under discussion are illustrated above. (Figs. 4–6, 8–10, 14–19.) Still better results were obtained in some of the remaining cases not illustrated; in others less satisfactory results were obtained.

In eleven of the 101 cases no improvement resulted and a brief report of these cases may help to indicate some of the possible causes of failure and methods of preventing them in the future.

Case XI.*—E. A. C., Wesley Memorial Hospital (118899), May 21–25, 1925. This patient, a physician of thirty-one years, developed a tendon-sheath infection of the left middle finger shortly after sustaining a needle puncture wound of the finger-tip. Upon admission to our service two and one-half years later the finger was fixed in flexion.

At operation under local anæsthesia the tendons were freed from their intrathecal adhesions and an anterior capsulotomy performed at the proximal interphalangeal joint. A free transplant of fat from the thigh was wrapped about the freed tendons. Following operation a part of the skin flap and underlying tendons became necrotic and sloughed. The raw surface was subsequently covered elsewhere with a pedunculated graft from the adjacent ring finger. At the same time the proximal segment of the remaining tendon was sutured to the base of the middle phalanx.

March 14, 1928, he wrote: "I am able to flex the finger fully at the metacarpophalangeal joint and the proximal interphalangeal joint. Extension at the metacarpophalangeal joint is also complete. I am able to extend the phalanges only slightly beyond a right angle."

Figure 20 indicates the final result in this case, a very creditable result for which we can claim no credit, as our operation, because of the infection which followed it, resulted in failure.

* This group of cases is numbered XI to XXI in order to avoid confusion with the group of cases whose histories were detailed above.

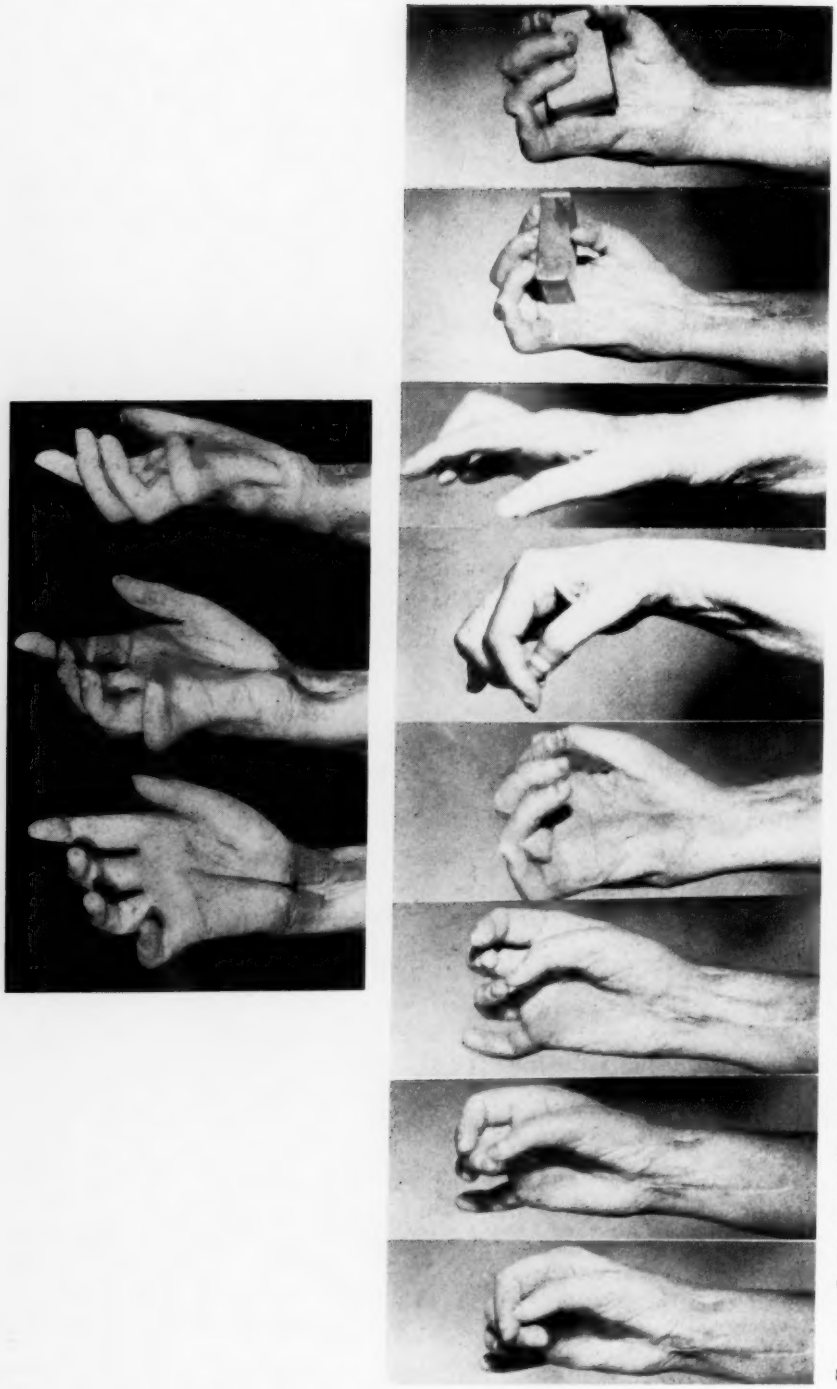

FIG. 19.—Same case as illustrated in Fig. 18. Upper Row—Appearance of hand before operation. The fingers and thumb were motionless. Lower Row—Result one year after insertion of tendon grafts.

CASE XII.—A. F. H., Wesley Memorial Hospital (96141), December 5–17, 1921. This patient, a physician of thirty-eight years, developed an acute streptococcic infection of the right index finger five days after scratching the volar surface of the middle phalanx while performing a tonsillectomy. The infection spread to the tendon sheath and to the thenar space; later a localized abscess formed over the dorsal surface of the lower end of the forearm, and the flexor tendons of the index finger eventually sloughed.

Twenty months after the onset of the infection the median longitudinal scar on the volar surface of the finger, representing the incision through which the infection had been drained, was excised, the fibrous cord-like remains of the flexor tendon sheath isolated and shortened, and surrounded with a free transplant of fat from the abdominal wall. An arthroplasty was performed at the distal interphalangeal joint. Healing took place without infection, and he left our care shortly afterward.

FIG. 20.—(Case XI.) Final result obtained in a patient in whom the flexor tendons of the middle finger had been destroyed by infection, and in whom tenolysis and the use of a fat transplant had again been followed by infection.

Ten years later, September 16, 1931, he wrote: "The best I could get out of my right index finger was passive flexion, and as it stuck out straight due to the fact that the extensors were strong and the flexors did not work, I had the finger amputated at the junction of the proximal and middle phalanx.

"I am sorry that I could not get the full use of my right index finger, but the right middle finger compensates very well, and as my surgical work on the eye makes it necessary for me to be ambidextrous, I get along very well, and do not notice the absence of the two distal phalanges of my right hand."

This patient was one of two (Cases II and VI) in whom amputation of the affected finger was finally performed to prevent it from interfering with the usefulness of the hand.

CASES XIII and XIV.—G. B., Wesley Memorial Hospital (137034), March 4–17, 1928; L. D., Wesley Memorial Hospital (141947), December 6, 1928–January 11, 1929. In both of these patients, the first a man of thirty-seven, the second a woman of forty-

three, the flexor tendons of the right index finger were partially destroyed, in the first case as the result of a spreading infection, in the second as the result of an unsuccessful tendon suture following tendon division from a porcelain faucet injury. In both cases the lost flexor tendons were replaced by a graft, and the graft attached to the distal phalanx by passing it through a drill hole in its base. In both cases this attachment failed to hold and no restoration of the ability to flex the finger was accomplished.

CASE XV.—H. S., Wesley Memorial Hospital (130085), February 22–March 1, 1927. This patient sustained a division of the flexor tendons of the right little finger as the result of a glass cut in December, 1925. An unsuccessful tendon suture was carried out a month later; the finger remained fixed in flexion.

Upon admission to our service thirteen months later the fibrosed tendons were excised and replaced by a tendon graft from the foot. Wound infection developed after operation, the tendon graft was lost and no helpful result was accomplished.

CASES XVI and XVII.—D. B., Passavant Memorial Hospital (4017), September 25–December 11, 1930; H. S., Passavant Memorial Hospital (5755), March 13–May 19, 1931. In both of these patients, young men of twenty-two and twenty-six years, respectively, the flexor tendons of the right middle finger were destroyed as a result of a slight injury which went on to a suppurative tenosynovitis and destruction of the tendons. In both cases a pedunculated flap from the abdominal wall was used to replace the scarred contracted skin over the volar surface of the finger and a tendon graft laid underneath the skin flap. In the first case no improvement resulted, and amputation of the finger was subsequently performed to remove a finger which could not be flexed and so became a handicap in the use of the hand. In the other case a slight restoration of flexion was accomplished, but not sufficient to justify the time and effort expended. In both cases the fibrosis which had developed about the interphalangeal joints, in addition to the fibrosis which developed about the graft itself, proved an insuperable obstacle to restoration of the power of flexion.

CASE XVIII.—E. H. S., Wesley Memorial Hospital (82796), December 4–9, 1919. This patient, a physician of forty-three years, developed an acute spreading infection of the right index finger following the appearance of a small pustule on the medial aspect of the distal interphalangeal joint. He stated that six incisions were made to secure drainage and that the infection persisted for about ten weeks. It finally resulted in an ankylosis at both interphalangeal joints.

December 5, 1919, the fibrosed remains of the flexor tendons were freed and an arthroplasty performed at both interphalangeal joints. Free fat transplants from the thigh were interposed between the bone surfaces.

December 17, 1930, he stated: "I regret to say that both joints are ankylosed in the straight position."

CASE XIX.—A. H., Wesley Memorial Hospital (144549), May 19–June 22, 1929. This patient, an automobile mechanic of thirty-five years, received a compound injury of the right hand from flying steel December 29, 1927. The thumb was amputated at the interphalangeal joint; the fingers were cut in a number of places. The proximal phalanges of the middle and ring fingers and the metacarpal of the little finger were fractured. The fractures were reduced immediately and again a few days after the injury. The middle and ring fingers were dressed in acute flexion for nine days.

On admission to our service fifteen and one-half months after the injury his chief disability consisted in an inability to flex the middle and ring fingers into the palm. (Fig. 21, a.) The following day an incision was made on the radial side of each of the affected fingers and the tendons freed from the adhesions which bound them to one another and to the flexor sheaths. After they were freed by putting tension upon the flexor tendons exposed in the palm it was possible to flex the affected fingers completely into the palm. Free fat transplants from the abdominal wall were laid underneath the the digital portions of the freed tendons.

Complete healing was delayed until eighteen days after operation because of a low-

grade infection which developed in the operative wounds. At that time physical therapy was begun and continued for sixteen days. The patient returned to his former work July 5, 1929.

February 17, 1930, the patient stated he did not think the operation had resulted in any improvement (Fig. 21, d, e), but he was able to use his hand effectively at his former occupation.

CASE XX.—B. M., Passavant Memorial Hospital (3106), June 22–July 25, 1930; (4384), November 3–6, 1930. This patient, a woman of twenty-five years, developed a firm flexion contracture of the right little finger following a division of the flexor tendons in an automobile accident, and three subsequent unsuccessful attempts at repair.

Upon admission to our service a tubed flap of skin and subcutaneous tissue was applied to the finger to replace the firm contracting scar on its volar surface. Subsequently a tendon graft was inserted underneath the flap to replace the excised remains of fibrosed tendons.

As in Cases VI and VII little improvement resulted because of our inability to counteract both the fibrous tissue formation, which tended to fix the interphalangeal joints in flexion, and the reformation of fibrous tissue about the graft.

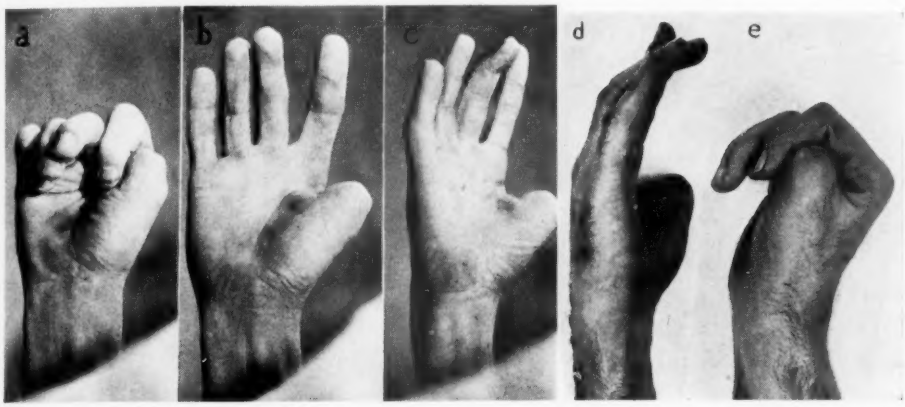


FIG. 21.—(Case XIX.) Limitation of flexion of middle and ring fingers following compound fractures of the proximal phalanges and fixation in a flexed position. (a), (b), (c) Condition before operation. (d), (e) Failure of improvement after tenolysis of the digital portion of the flexor tendons because of low-grade wound infection.

CASE XXI.—H. W., Wesley Memorial Hospital (124528), April 14–May 17, 1926; (128610), November 25–December 1, 1926; (135906), December 27, 1927–January 21, 1928. This patient, a boy of fifteen years, sustained a severe injury of the right hand in November, 1925, from an accidental discharge of a shotgun at a distance of three feet from his hand. The skin and tendons were torn from the proximal half of the palm, and a number of the carpal bones were fractured. He remained in the hospital for a month after the injury.

On admission to our service April 14, 1926, the fingers of the right hand were immobile, held in slight flexion. A deep healed irregular scar extended obliquely across the palm, approximately at the level of the base of the thumb. There was complete anæsthesia in the area of median-nerve distribution.

April 16 the scar tissue was dissected from the palm, the thumb abducted from the hand, and the hand laid under a double pedicled flap raised from the right lumbar region. The flap was separated from its attachments May 10 and the raw edges sutured to the hand.

November 25 the patient returned to the hospital, and on the following day through an incision along the ulnar border of the flap, the palm was explored. The median nerve

and flexor tendons were freed as completely as possible from a dense mass of scar tissue. The divided flexor tendons of the ring finger were sutured. Because of the extensive gap between the divided ends of the tendons of the little finger the distal segments of these tendons were united by lateral suture to the tendons of the ring finger. Even when the dissection was completed it was not possible to draw the fingers easily and completely into flexion by traction upon the flexor tendons in the palm. The operative wound healed by primary union.

December 27 the patient re-entered the hospital and tendons from the left foot were transplanted into the palm to substitute for the scarred and fibrosed flexor tendons of the little and ring fingers.

April 26, 1933, his physician in California wrote: "At the present time he is suffering from rather marked flexion contractures of the middle, ring and little fingers and is partially incapacitated from following his proposed career of athletic coach and physical education director. . . . I feel, however, that a further plastic operation plus adequate physical therapy will restore this hand to somewhat normal function."

These cases help to emphasize several facts, first of all the very obvious one that post-operative infection is almost certain to cause failure, and nothing in the way of post-operative care or physical therapy can counteract its unhappy results. Second, that to free the fibrosed remains of flexor tendons and tendon sheath from the soft tissues to which they have become adherent as the result of a suppurative tenosynovitis or an injury which has been unsuccessfully operated upon, and expect the freed scar tissue to act as a gliding tendon and draw the finger into flexion is an almost hopeless procedure. Third, that it is necessary to secure a firm and permanent attachment of a tendon graft to the distal phalanx if the graft is to draw the finger into flexion. Fourth, that mobility of the interphalangeal joints is essential to free movement of the fingers, and unless it is possible by an operative procedure or physical therapy or both to overcome the scar tissue formation which invariably takes place about the small joints after an infection or injury freeing of fibrosed tendons or their replacement by tendon grafts cannot be expected to bring about restoration of movement.

In considering the possibilities of restoration of function in cases such as these, and the results obtained, two factors in addition to those mentioned seem to us of great importance: The patient's will to secure a useful hand and the time factor. It is hardly necessary to point out that if a patient is determined to do everything in his power to secure the maximum degree of usefulness he will accomplish much more than the patient whose mind is intent on the extent of his disability and the financial compensation he can obtain. The patient whose history is detailed under Case IV, for example, both because he used his hand constantly at his work as a blacksmith, and so received the best kind of physical therapy, and because he was determined to regain the complete use of his hand, eventually secured an excellent functional result. The patient whose history is detailed under Case VI, on the other hand, has just recently refused to return to his physician for examination, apparently for fear of having his compensation for partial disability diminished or discontinued.

The time factor is also of great importance.* Muscles which have remained long inactive and undergone a considerable degree of atrophy can contract normally only when their tendons are first freed from contracting scar tissue, or are again united to their normal insertion. With restoration of movement made possible and with gradual regeneration of muscle fibres taking place day by day under the stimulus of active movement a constantly increasing degree of muscle power develops. As a result patients who leave one's observation after a few weeks or months of post-operative physical therapy often return after several years with a considerably greater improvement of function than one had anticipated, and this increasing improvement with time and use has been one of the most important factors in stimulating us to bend our efforts toward improving our technic and toward carrying out every detail of treatment that offers assurance of helping to bring about the desired result.

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* "If the patient is willing to undergo two or three operations, and to carry out treatment for a number of months after operation the results will surpass one's expectations. Improvement in these cases does not cease at the end of six months or a year, but will continue for four or five years; the patient should be inducted into work in which he can use his hand, and should be advised and urged to use it." (Kanavel.[17])

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# TRANSTHORACIC ABDOMINAL HERNIA

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Penetrating wounds above or below the costal arch may involve either the thoracic or abdominal cavity separately or both simultaneously. In the latter event those in which the point of entrance lies above the costal margin may pass through the diaphragm into the abdomen, and conversely, those which first enter the abdomen may pass obliquely through that muscle into the thorax. Such wounds are necessarily often complicated by the penetration of vascular and vital organs which lie in close proximity to the diaphragm and in that event, patients frequently die quickly from hæmorrhage or, more tardily, from the penetration of an unclosed orifice of some hollow viscus. There is always a mathematical possibility that penetration may occur without opening either pleural cavity or the pericardium and that such a wound may even extend onward through the diaphragm and its lining peritoneum without damage to either a thoracic or an abdominal viscus. Such a possibility is permitted by the fact that in passing from the diaphragm to the thoracic wall, the pleura leaves the most dependent lateral angle of the thoracic cavity and the adjacent attached diaphragm on either side uncovered—the so-called "costo-mediastinalis" sinus—of which, owing to the variation in the dimensions and symmetry of this interesting anatomical space, further detailed description is unnecessary. It is precisely through this extrapleural space and above its inferior or diaphragmatic surface that a penetrating wound may enter both chest and abdomen without material damage.

It is a well-known fact that herniæ frequently develop through scars in the abdominal wall. Through similar scars in the diaphragm, as well as through congenital defects in that muscle, hernia of one or more of the abdominal contents may take place. In that event the hernial sac and its contents, even when of large size, are confined within the thoracic cavity. The thoracic wall seems to be proof to the pressure that such a hernia may exert and the writer has found no instance of a diaphragmatic hernia "pointing" through an intact intercostal space. Protrusion of a portion of the lung through a penetrating wound of the chest has been observed. This strictly is a "prolapse"—not a hernia—although frequently either term is used interchangeably. When such a prolapse is reduced—and that usually is readily accomplished—and the wound is closed, no subsequent hernia ever develops. Even after resection of one or more ribs, so commonly done for the drainage of empyema, with the exception of Lehman's case, no hernia has ever been observed. In that case, reported in the Annals of Surgery for May, 1927, hernia followed five years after the opening of a subdiaphragmatic abscess,

in which extensive portions of the eighth and ninth ribs were sacrificed. Through the ensuing scar, to the weakness of which both the partial loss of the ribs and the associated necrosis of the diaphragm contributed, a sliding hernia containing the spleen developed. In the writer's cases, herewith reported, according to the patient's account, the bayonet wound quickly healed without thoracic or abdominal complications and consequently without any loss of substance in either the thoracic wall or diaphragm.

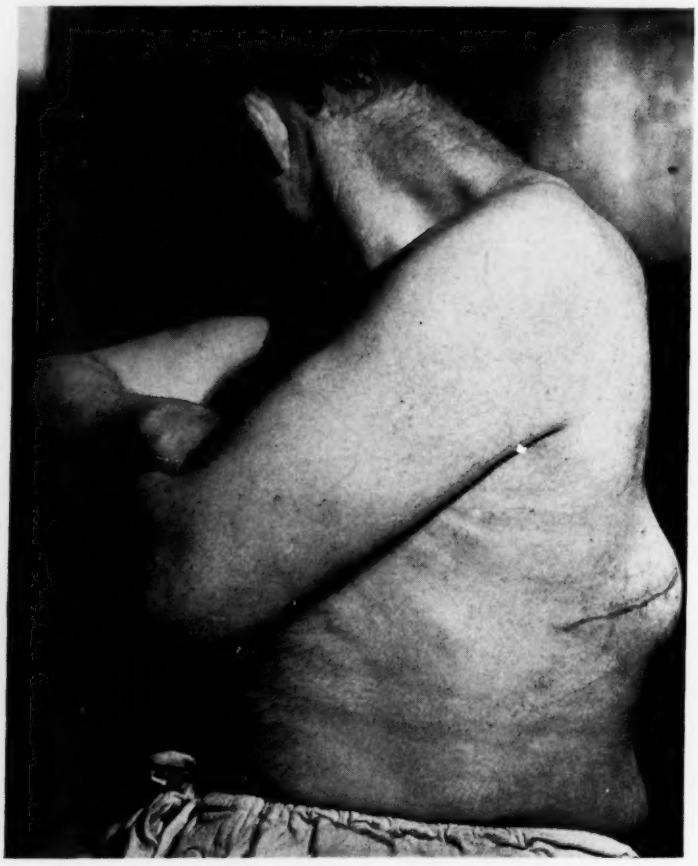

FIG. 1.—Transthoracic abdominal hernia.

A. D., aged forty-eight years, admitted to the Knickerbocker Hospital in 1930. During the World War the patient, previously robust and healthy, received a bayonet wound in the left side. So far as can be ascertained, this caused neither thoracic nor abdominal complication and healed promptly.

One day prior to the patient's admission to the hospital, on lifting a heavy trunk, the man experienced a sudden and sharp pain in the lower left chest in the scar resulting from the above wound and for the first time he noticed a swelling in the scar which increased perceptibly in size during the following twenty-four hours. There was also pain on inspiration.

Examination revealed a swelling in the lower left chest, several inches posterior to the axillary line. (Fig. 1.) It was unaffected by position or by coughing. There

was no impulse whatever. It was doughy in consistency. It was insensitive, and firm pressure failed to reduce its size. It was flat on percussion. In general, it presented the usual features of an irreducible epiplocele. Physical examination of both chest and abdomen was negative. There was no change in vocal fremitus or of the respiratory murmur over either lung. X-ray examination showed that the diaphragm was normal in the excursion of its movement and that it was symmetrical without change in its contour. There was only a slight shadow corresponding to the position of the swelling. The bony outline of the chest wall and both lungs were normal.

On operation, the swelling, separated from its adjacent tissue, disclosed a well-defined pedicle emerging through an opening in the tenth intercostal space. The sac consisted of well-defined connective tissue without the glistening appearance common to either the pleura or peritoneum. On opening the sac a mass of omentum, the size of an orange, appeared, firmly adherent to the neck and adjacent surface of the sac. Traction on the omental mass, as it was separated from the interior of the sac, caused some respiratory embarrassment. The mass was amputated after separation of the adhesions and ligation with catgut and gently returned through the opening in the diaphragm into the abdomen. The opening was closed by the suture of reflected periosteum from the surface of the tenth rib, over which the intercostal muscle and the fascia were sutured separately with chromic gut. The pleural cavity was not opened and the partially adherent stump of the omentum to the peritoneum prevented any frank exposure of either the peritoneal cavity or its contents. Unfortunately, recent attempts to locate the patient have proved unsuccessful.

What particular operation is best adapted for the relief of this condition is debatable. Preliminary exposure of the hernial sac and its contents through an overlying incision is, of course, essential. Adequate reduction may possibly require a separate abdominal incision. The hernial canal can then be satisfactorily closed from below, assisted by pressure of the affected part of the diaphragm from above; or, vice versa, aided by upward pressure of the diaphragm, the hernial orifice can readily be sutured through the original thoracic incision. That such an ideal procedure was not applied in the present instance was due to a disinclination to incur the risk of a ventral hernia through an abdominal scar. Moreover, the danger of opening the pleural cavity and especially of the resulting pneumothorax seemed to justify the attempt to close the hernial orifice through a comparatively small intercostal incision in the manner described. In the event of a recurrence a more complete exposure of the hernial orifice and its subsequent closure either from below or above, or both, could be attempted in the manner described as in the usual diaphragmatic hernia.

It is of interest to note that bayonet wounds, from which the patients survive, in any war are rare. Not one was observed by any member of the staff of Evacuation Eleven during the Argonne Campaign, nor was any mention made of such a wound in the hospitals of Tours and Orleans to which the writer was attached as consultant after the Armistice. Even in the Civil War, in which the lines were in much closer contact, and where it is said that opposing soldiers in the "bloody angle" at Spottsylvania endeavored to bayonet their adversaries by thrusts between the logs by which the earthworks were reinforced, the late Doctor Weir, a former President of this Association, and in charge of a large hospital at Frederick, Md., from the battle

of Antietam on, informed the writer that he never saw a bayonet wound during his entire term of service.

The discrepancy between the history and the actual lesion as disclosed by operation is also worthy of comment. In place of an acute condition of twenty-four hours' duration as indicated by the history, the hernia, although probably of considerably smaller size, must have existed for years. Such a discrepancy is not uncommon in inguinal and femoral herniæ, in which the patient's attention is directed to the swelling by sudden onset of pain, and when, shortly afterward, on operation, the omentum is found not only firmly adherent to the sac but so completely plugging its narrow communication with the peritoneal cavity as to have prevented any trace of impulse on prior physical examination.

The writer is greatly indebted to Doctor Lehman for calling attention to the case which he had previously published in the ANNALS OF SURGERY, mention of which he had failed to notice in the Index Medicus. It is also of interest to note that the term of "transthoracic abdominal hernia" was selected by both Doctor Lehman and himself, independently, to describe what in fact is a surgical curiosity.

DISCUSSION.—DR. EDWIN P. LEHMAN (University of Virginia) remarked that Doctor Eliot had mentioned a case that he reported several years ago. It is unquestionably a rare condition and it had seemed to him worthwhile to present it for that reason. The similarities and the differences between his case and Doctor Eliot's are interesting. The case was reported in the ANNALS OF SURGERY, 1927, p. 797.

This patient gave a history of having had a subphrenic abscess some five years before which had been treated elsewhere. He had noticed bulging in the left lower thorax for three years which had been associated with pain for only about three weeks. The important features of the case were a bulging in the left lower thorax in which a sharp edge could be felt; X-ray showed at times a loop of colon in the protrusion and at times a solid body which later proved to be the spleen. Intratracheal insufflation with lipiodol showed the absence of lung in the hernia. At operation a sliding hernia was found involving the attachment of the spleen and the colon. The diaphragm was attached to the seventh rib. There was a defect involving the eighth and ninth ribs for a distance of about six inches. Closure was obtained by using the spleen as a tampon and suturing it to the edges of the defect. The closure was reinforced with fascial sutures employed by Doctor Galley's technic. At the end of seven months the defect was entirely firm. A recent report, nearly seven years after operation, is that the patient is entirely well.

DR. FRANK K. BOLAND (Atlanta, Georgia) said that during the past ten years he had had under observation 750 cases of penetrating wounds of the chest. Three-fourths of these were made by stab wounds, a great many by ice picks, and one-fourth by gunshot wounds. In all of these cases they had had no instance such as Doctor Eliot had described, no hernia of this kind. He, however, could speak of especially the lack of infection in these penetrating wounds of the chest. In their series only twelve cases of empyema developed, with one death, and only one pulmonary abscess.

In the text-books one is led to believe that infection is very apt to follow penetrating wounds of the chest, but it has not proved so in their experience. In many of these cases, other wounds that were made at the same time became infected but the pleural wound did not. He thought the pleura must be endowed with greater power to resist infection than had been thought in the past.

Dr. John F. Connors (New York City) said that about two years ago it was decided at the Harlem Hospital that their mortality was too high from hæmorrhage in stab wounds of the chest. It was decided then that these cases should be operated on and the internal mammary and intercostal arteries ligated. During the last year they had had forty penetrating wounds of the chest with no mortality. In these cases they had found two diaphragmatic herniæ. One of these was unrecognized. The cases died from a pyopneumothorax due to the gangrenous area of the stomach which had penetrated the diaphragm and ruptured. The other case was recognized as the omentum protruded through the diaphragm. This was ligated, replaced into the abdomen and the opening in the diaphragm was closed. It is very obvious that the diaphragm can be much more readily repaired from above than from below. It is very astounding to open one of these chest cavities with a collapsed lung and find the mediastinum misplaced, with the respiratory efforts interfered with. When the lung is once pulled to the chest wall, the breathing becomes regular, due to the stabilization of the diaphragm. In some of the cases they had found as many as three perforations of the diaphragm. A strange observation which they had made was that where there is a penetration of the diaphragm, no matter how high the incision was inflicted, there was no wound of the lung.

Dr. Stuart W. Harrington (Rochester, Minn.) had never seen a hernia of this type. In his experience of sixty-one cases of diaphragmatic hernia, fifteen of the herniæ were of traumatic type. Of these fifteen, ten were caused by the indirect force of increased intra-abdominal pressure resulting from crushing types of injury; five were the result of direct injury to the diaphragm. Two of the five herniæ mentioned were caused by gunshot wounds, one by a knife wound, one by a left subphrenic abscess rupturing through the diaphragm into the lung, and the fifth evidently either by trauma from a tube introduced into the pleural cavity at the junction of the diaphragm for drainage of empyema or by trauma from the irritation of the cut ends of the resected ribs. This latter case somewhat simulated the case Doctor Eliot has reported. The thoracic wall bulged slightly at the site of the scar which remained after drainage of the empyema, but the bulging was not caused definitely by the herniated viscus, which was the stomach. The stomach had passed through an opening in the diaphragm close to the costal wall, and immediately proximal to the scar, but it had passed on higher into the thoracic cavity until about a third to a half of the stomach was within the pleural cavity. The case in which the hernia resulted from a ruptured subphrenic abscess is probably the most interesting and rare of the group, for he had found no similar case reported in the literature. The subphrenic abscess was caused by an acute abdominal infection, probably a ruptured appendix; the patient was ill with a septic type of fever for several weeks, and during a violent attack of coughing expectorated about 1,000 cubic centimetres of pus, following which he completely recovered, and four weeks later he left the hospital, to which he had been taken. After about four to six weeks he began to complain of indefinite gastric distress and pain immediately after meals. This became progressively worse later, and was associated with vomiting, which progressed to almost complete gastric obstruction and resulted in gastric tetany. He had lost about twenty pounds at the time of his admission to the clinic. Röntgenological examination was not helpful in establishing the diagnosis, for it appeared in the röntgenograms that the stomach was adherent to the diaphragm. At operation it was found that practically the entire stomach had herniated through an opening in the posterior median portion of the left dome of the diaphragm. The stomach was replaced in the abdomen, and the hernial opening in the diaphragm was closed, with complete relief of symptoms.

Dr. Kellogg Speed (Chicago, Illinois) in 1916, while working with the Twenty-Third General Hospital, A. E. F., France, said they had a chest ward of thirty beds

constantly filled with battle casualties. He recalled two that fit in somewhat with Doctor Eliot's description. One was a bayonet wound which, on the fourth day after reception, without discharge or infection, caused the patient distress and cough and some cyanosis. There were no X-ray facilities at the time to examine it, but on suspicion the speaker opened the chest in a long, curved wound around the eighth rib and found a long tear in the diaphragm. This was sutured with catgut and the patient made a recovery but developed an empyema which was later drained. No hernia of the diaphragm followed although it might easily have developed if suture had not been performed.

The second case was a shrapnel wound between the seventh and eighth ribs near the posterior axillary line. The patient went about a week before he developed serious symptoms. Then a swelling appeared. This went on to redness, and eventually necrosis, and from it poured out fæces. The patient had developed a rupture of the diaphragm, the transverse colon or splenic flexure had passed up through and eventually ulcerated through the shrapnel channel. He had a fecal fistula in the seventh interspace near the posterior axillary line.

Doctor Eliot (closing the discussion) remarked that mention of any unusual or rare condition frequently brings to light one or more similar cases. Thus, recently a case of hernia of the lung following resection of the lower ribs for empyema has been called to his attention. It was indeed difficult to understand why such a hernia was not of more frequent occurrence.

The cases mentioned by Doctors Harrington and Speed were evidently not associated with hernia through an intercostal space. The importance of distinguishing between such a hernia and prolapse was referred to in the paper. The former condition is not uncommon either with or without penetration of the diaphragm. If limited to a prolapse of the lung, immediate reduction and retention is usually possible. If complicated by prolapse of one or more abdominal viscera exploration and possible repair of the resulting damage may be necessary. Penetrating wounds of the chest without prolapse are preferably treated conservatively. The associated hemothorax can be usually successfully aspirated if there is dyspnœa. If aspiration fails, the blood clot can be removed through a simple incision under a local anesthetic. In some twenty-five cases treated conservatively during the recent World War in Evacuation Hospital No. 11, no instance of infection occurred and the results were uniformly satisfactory.

# DUODENAL STASIS: DUODENO-JEJUNOSTOMY

By Eugene H. Pool, M.D., Walter L. Niles, M.D., and Kirby A. Martin, M.D.
of New York, N. Y.

Our motive for presenting the subject of chronic duodenal stasis and its surgical treatment is that the condition is not given its proper weight or balance in the minds of most clinicians.

Stasis of the duodenum definitely occurs; it may cause serious and prolonged symptoms leading to chronic invalidism; the trouble may be corrected by timely surgery. This statement will doubtless excite immediate contradiction for in most medical communities clinicians' eyes are closed to the possibilities of such a condition. Their eyes and minds circulate around the periphery but do not focus on the hub. Cases with definite stasis in which the symptoms indicate treatment and at times operation are overlooked. The impression is extensively accepted that "duodenal stasis is not a clinical entity but a radiological sign seen in various conditions such as cholecystitis, duodenal ulcer, *etc.* On the other hand, in a few instances there seems to be an undue bias towards the condition; too much is attributed to the duodenum so that it is the first thing looked for and at times the only thing seen. Under these conditions there is too much duodenal surgery. In a word, the condition is not generally given its proper value and it is upon this that we wish to dwell.

The cases may be divided into three main groups:

(1) Fixation, distortion or compression of the first or second portions of the duodenum by bands or adhesions, notably by extension or modification of the hepato-duodenal ligament. These may produce a mild irritation with transient stasis and reversal of peristalsis. (Niles[38]; Kantor[32], Shattuck[42] and Imboden[42].)

We have had considerable experience with this type and have had favorable results by division of bands and by mobilizing and depressing a high fixation or angulation of the duodenum.

(2) Temporary loss of tone with impairment of the function of the duodenum is not uncommon. It results from infections, fatigue or emotional upsets.

(3) Obstruction at or near the duodeno-jejunal junction.

We will confine ourselves to this third group which is sufficiently definite to warrant analysis.

deBeule,[17] in 1931, presented a comprehensive discussion of the causes of chronic duodenal stasis. The following is a summary of his classification:

(1) Mechanical obstacle; (2) duodenal paralysis by inflammatory process; (3) disequilibrium of innervation of the duodenum.

(A) Mechanical obstacle.

(I) *a.* Intrinsic, due to congenital malformations (rare); atresia, angulations and volvulus due to long duodenum.

*b.* Intrinsic, due to acquired lesions. Cicatricial contraction following ulcer, benign tumors, malignant tumors.

(II) *a.* Extrinsic, congenital; membranes, folds (adhesions). These are called by Duval[22] stenosing periduodenitis; above the thickened colon and retracted hepatoduodenal ligament; submesocolic; membranes at or over the duodeno-jejunal junction (Mayo,[36] Duval[22]) or over the angle between the third and fourth portions (Taylor[45]); retraction of Treitz's muscle.

*b.* Extrinsic from acquired lesions. Compression, stenosis, angulations due to periduodenitis; compression by mesenteric pedicle.

The duodenum, lying between the aorta and superior mesenteric artery may be compressed by the latter. Conditions bringing about these results are abnormal shortness of the mesentery (rare), and, more particularly, enteroptosis.

(B) Stasis through duodenal paralysis caused by inflammatory process (duodenal ileus).

Intrinsic: duodenitis.

Extrinsic: cholecystitis; pericholecystitis; possibly due to distant infections as appendicitis, entero-colitis, pelvic infections. de Vadder[19] holds that compression may be due to the lymphatics; lymphatics passing anterior and posterior to the duodenum produce paralysis of the duodenum by toxins from elsewhere.

(C) Stasis due to disequilibrium of the duodenal innervation. There exists a series of cases where stasis is provoked sometimes by spastic contracture at different levels of the duodenum, sometimes by pronounced atonic flaccidity of the wall, without either local or distant obvious cause. It is a question whether duodenal spasticity corresponds to a form of vagatonia, and whether atony is related to sympatheticotonia. In two cases, in which the syndrome of duodenal stasis appeared at irregular intervals, and the radiographs indicated no notable arrest in the duodenal transit, intervention showed a greatly dilated duodenum especially at the genu inferior with large retention of duodenal contents. Duodeno-jejunostomy was of great benefit in both cases.

*Historical.*—In 1900, Petit[39] described a case of chronic compression of the duodenum by the mesentery which is said by Duval, Roux and Beclere[22] to be the first report of such a condition. In connection with this case Petit worked out on the cadaver an operation for duodeno-jejunal anastomosis.

That the condition was recognized previous to this has been shown by Bockus[12] in a good review of the subject. He states that Rokitansky,[41] in 1849, was the first to suggest that compression of the duodenum by the superior mesenteric vessels might be responsible for dilatation and stasis within the duodenum. Kellogg[33] refers to case reports of duodenal obstruction by Boener,[13] in 1752, and by Yeats,[49] in 1820, which are of historical interest. In 1889, Glénard[27] suggested that the drag of a dilated ptosed stomach causes at times a dilatation of the duodenum. Kundrat[34] (1891) described cases

of persistent incomplete obstruction which he attributed to compression by the root of the mesentery. Albrecht[1] (1899) spoke of it as duodenal constriction due to mesenteric traction.

In 1900, Robinson[40] described his impressions gathered from a study of thirty autopsied cases: he states that in subjects with visceral ptosis and coils of intestine in the pelvis, the superior mesenteric artery and vein compress the transverse segment of the duodenum and cause dilatation of the part proximal to these vessels. He attributed many deaths indirectly to duodenal occlusion in people over forty-five, particularly multiparæ. Connor[16] (1906) estimated that two-thirds of a large series of cases of acute dilatation of the stomach had a concomitant dilatation of the duodenum.

Bloodgood,[10] in 1907, discussed three fatal cases of gastromesenteric ileus in all of which obstruction began abruptly at the junction of the duodenum and jejunum beneath the mesenteric vessels. He suggested that in such cases a duodeno-jejunostomy may be indicated. Stavely,[44] in 1908, performed the first duodeno-jejunostomy on a living patient. This was done in a case of chronic gastro-mesenteric ileus and proved successful.

We will not discuss such procedures as gastro-enterostomy, which has no indication, nor resection (Bloodgood[10]) or plication of the colon (deBeule[17]), which have been employed. Resection of the colon was suggested (Bloodgood[10]) on the basis that at times the pull on the mesentery of the small intestine by a prolapsed cæcum may be the cause of the obstruction.

In 1913, five years after Stavely,[44] Bartlett[9] did the second duodeno-jejunostomy using a Murphy button to relieve a vicious circle. In 1921, Kellogg[23] stated that the total number reported to that date was fifty-eight with no mortality. In 1927, Kellogg reported a series of seventy-seven with two deaths. The late results were reported as satisfactory. A number of other series have been reported.

Wilkie,[45] 1927, sixty-four operations; with 6 per cent. mortality.

deBeule, 1931, a series numbering eighty with excellent late results and only one death. He calls attention to cases of duodenal stasis secondary to extrinsic inflammatory processes, cholecystitis, appendicitis, metritis or inflammation of adnexa and believes that the stasis may regress after local operations, but at times he combines the local with duodeno-jejunostomy.

DeVadder, 1928, twenty-six operations.

Weiss,[48] in 1925, reported thirty-four cases with careful analysis of results. In twenty-five, duodeno-jejunostomy was done with twenty excellent results, two fair, one recurrence after improvement, two lost track of. This closely corresponds with the usual reports of results.

Friedenwald, Morrison and Feldman[20] report on twenty-four cases, eighteen of whom were males and six were females, in contrast to the statement of most authorities that this affection occurs twice as frequently in females as in males. The ages of the patients lay between twenty and sixty. Twenty-three of these patients were treated by medical measures with at least satisfactory temporary relief. In a single case, which resisted this form of treatment, duodeno-jejunostomy was followed by complete recovery. Medical management they state is quite satisfactory especially in those cases due to viceroptosis.

Appelmans, Van Goidsenhoven and Boine[4] reported twenty-nine cases of chronic stenosis, due to different causes, twenty of which were treated by duodeno-jejunostomy.

In fourteen cases caused by compression by the mesenteric artery, there were ten very satisfactory results, two fair results, and two operative deaths. In the six other cases associated with pericholecystitis, ulcer, appendicitis, and stenosing duodenitis, there were five good permanent results, and one temporarily good result, followed later by death. The total results in the twenty cases are, therefore, fifteen satisfactory results, two fair results, two operative deaths, and one death after six weeks.

The reasons for lack of success have been analyzed by Delbet;[18] he states that sometimes the duodeno-jejunostomy permits a supramesocolic stasis to persist, and some-

times it fails completely to aid the difficulty in evacuating the stomach, which so often accompanies duodenal stasis. To obviate these inconveniences, he says, combined operations have been done; duodeno-jejunostomy associated with liberation of adhesions; duodeno-jejunostomy and gastroenterostomy performed simultaneously. But even with operations as complex as these, the complete cure of the patients is not obtained. For this reason, Delbet conceived the idea of a large anastomosis between the stomach and the duodenum, on the one hand, and a jejunal loop, on the other. This operation he has termed "gastro-pyloro-duodeno-jejunostomy." Incision is made in the pyloric vestibule, the pylorus and the first portion of the duodenum, and anastomosis is here made with a loop of the jejunum. In this way there is assured a good evacuation of both the stomach and duodenum. This operation has been performed by Delbet or his pupils almost 100 times. The three cases of death reported in a study of the first fifty cases remain the only mortalities. Delbet believes the results of this operation are superior to those given by the other methods.

Kellogg, 1933, has brought the subject to date and reports some seventy-five duodeno-jejunostomies.

*X-ray as a Diagnostic Aid.*—The diagnosis of duodenal stasis by the aid of X-ray examination requires special consideration of the anatomy and physiology of this portion of the alimentary canal.

The duodenum is largely retroperitoneal. It possesses no mesentery and is relatively fixed in position. It is the widest part of the small intestine, the average width being four centimetres or more. It is also the shortest segment, being only twenty-five centimetres in length. It lies in close proximity to important abdominal viscera, liver and pancreas, both of which drain into the second portion of the duodenum.

The duodenum and the remainder of the small intestine bear the same relation to habitus as do the stomach and colon, *i.e.*, to contour, tone, motility and disease. These variations of habitus, we have been led to believe, are hereditary and more or less fixed, but we are coming to realize that they may vary widely depending upon good nutrition and health.

The duodenum functions in all of its various digestive measures principally as the receptacle for the digestive secretions and the channel through which the chyme is carried into the jejunum. In close relation to this process is the rich blood supply and the delicately controlled sympathetic nervous system which have to do with absorption, secretion and motility.

Normally in a sthenic individual the opaque meal remains in the cap only six to eight seconds, is discharged and makes its entrance into the jejunum in about eight to ten seconds. At the beginning of a meal it is not uncommon to see some disturbance of this normal duodenal rhythm such as puddling and cradling in the dependent portion and occasionally there is reversal of the peristaltic waves. Again at the end of a meal one may observe similar reversal of peristalsis. Some observers believe the duodenal contents are normally regurgitated into the stomach as a neutralizing process of the excess hydrochloric acid.

Alvarez[3] has pointed out that there is a balance between the emptying of the stomach and the holding back tendency of the small intestines. It appears that anything that stimulates the upper intestine will delay the emptying of

the stomach and conversely anything that stimulates the stomach will cause it to empty faster, thus throwing an increased load on the small intestines and especially the duodenum. From this supposedly normal there are many variations, some of which border on disease.

It is well recognized that a partial obstruction of the duodenum, even though it be of an intermittent type, may be sufficient to disturb this highly specialized and sensitive mechanism of motility whereas a more complete obstruction in the distal segments of the colon would go unnoticed. As Alvarez has stated, the gradients are steeper in the duodenum.

Dragstedt and Dragstedt[21] have demonstrated experimentally on dogs that extrinsic pressure on the duodenum equivalent to as little as six inches of water pressure is sufficient to cause death of the animal. Under such circumstances one might well understand that contriction from adhesions, bands, or pressure from the superior mesenteric vessels when in the upright position may in certain instances produce distressing symptoms.

It becomes apparent that the normal duodenal functions may be upset mechanically either by rapid emptying of the stomach or by narrowing of its lumen. In many instances, no doubt, the combination of these two factors is responsible for a break in the compensation of the duodenal function.

*Symptoms.*—Every case complains of indigestion, varying in severity from time to time. The symptoms are heaviness, weight or fullness, chiefly after meals, and usually soon after eating. This is often described as gas, and belching gives temporary relief, though some patients report that they feel as if they would be relieved if they could eructate, but are unable to do so. Some have soreness in the epigastrium and a few describe a twisting sensation with rumbling and gurgling. There is frequently distention of the epigastrium. Nausea is a variable symptom but most patients complain of it at times, though vomiting is unusual. Some complain of fullness while eating, sometimes after taking only a few mouthfuls of food. Small meals can often be taken without discomfort though large meals will produce severe indigestion.

Attacks of pain in the epigastric region are described by about one-half of the cases (nine out of eighteen in our series). The pain is occasionally very severe, sometimes requiring morphine for relief, and has been mistaken for biliary colic. It usually lasts for several hours, sometimes for days, and is frequently accompanied by vomiting. In one case the attack was so severe that the patient was sent to a hospital where a diagnosis of acute intestinal obstruction was entertained. These painful attacks are usually precipitated by fatigue or emotional crises rather than by indiscretions in diet.

Several patients observed that they were more comfortable when they remained recumbent after their meals and that the upright position made them feel weak, sometimes faint and nauseated. We have not observed that lying on the right side or assuming the knee-chest posture gave any more relief after meals than lying on the back. Headaches with a "gone feeling" in the pit of the stomach frequently accompanied the indigestion but these sensa-

tions disappeared when the indigestion was relieved. These symptoms are also frequently reported by patients with congenital high fixation of the duodenum.

Although constipation occurs in most cases it is not very severe generally and in a few the bowels have been irregular in action with occasional loose movements.

The duration of the history is usually a matter of years but it depends upon the age of the patient. Unlike congenital high fixation of the duodenum it seldom goes back to infancy or early childhood and in none of our patients have we elicited symptoms earlier than the age of fourteen. Most of them began in the latter part of the second decade or in the third decade of life. A woman aged fifty-eight never had indigestion until six months previous to examination when the usual symptoms came on after a period of severe mental strain. Several patients were unusually strong and well-nourished during infancy and childhood. The onset of symptoms is usually precipitated by an exhausting illness or by some psychic trauma or emotional strain. One of our patients is a nurse who stood three years of hospital training without a sick day but succumbed to the strain of directing a foreign hospital. Another dates her illness from the Great War, when her husband was reported missing for one month. A young woman began to have attacks of pain while involved in a hectic love affair.

All patients with this disorder lose weight and most of them become very thin—five of our operated cases weighed less than one hundred pounds at the time of operation.

The first impression at the initial examination is that they are hyposthenic types but it is our belief that they are not generally of that habitus. We have seldom found any considerable degree of visceroptosis upon physical or X-ray examinations and we have been impressed by the fact that when they have gained weight after operation or other treatment they do not represent the hyposthenic type at all. A patient who weighed ninety-eight pounds at operation and whom we classed as hyposthenic now weighs one hundred forty-five pounds and would be classed as hypersthenic. We have come to believe that the *habitus enteropticus* chiefly represents emaciation and loss of muscle tone.

Another constant feature of this group of cases relates to the psychic and nervous systems. They invariably develop instability of the sympathetic nervous system and, if unrelieved, always become psychoneurotic. The longer the history of indigestion the more profound the instability of the psyche. Two of our patients have been considered psychotic and all in whom the symptoms have persisted more than a year or two have been neurotic. Not one of our patients has given a history of nervous or mental instability previous to the onset of indigestion. The common symptoms are fatigability, headache, nervousness, palpitation, weakness, insomnia and anxiety, occasionally developing fixed ideas of inadequacy with depression. These

psychoneurotic trends seem to us more constant and more profound than in any other disorder of the digestive tract.

The appearance of a chronic case is very suggestive. There is often a muddy pallor of the skin which, combined with emaciation and weakness, suggests chronic intoxication. Mild to moderate secondary anæmia is the rule and three of our patients have had a slight elevation of temperature which has persisted for months and years. One patient is known to have had a slight fever (99° to 101° F.) for five years. Two of our cases developed definite attacks of tetany.

These symptoms raise the question whether some toxic substance is absorbed from the duodenum. One recalls that dogs die, apparently from a non-bacterial intoxication, within a few days after a closed duodenal loop has been made, and it is an attractive theory that in duodenal stasis toxins are absorbed which produce profound effects upon the nutrition and the nervous system. It is our belief, based upon repeated fluoroscopical examinations, that the duodenum may lose its tone in the absence of any definite pathology and that the resulting stasis may produce indigestion, headaches, *etc.*, which pass off when the duodenum regains its functional capacity. It is possible that people with a certain degree of organic obstruction may have no symptoms so long as the tone of the duodenum is good and can overcome or compensate for the slight obstruction. This surmise offers a reason why patients with organic partial obstruction may be free from symptoms until the muscular or nervous tone of the digestive tract becomes impaired. When that occurs it becomes increasingly difficult for compensation to be restored.

Aside from the evident malnutrition and asthenia there is little to be found upon physical examination. The patient usually is pallid and the skin is dry and rough. A variety of skin diseases may be noted, such as ache simplex or ache vulgaris, ache rosacea, and eczema. If the history of indigestion is long, one often finds scars of previous abdominal operations (eight out of eighteen in our series) and sometimes the scars are multiple. A moderate distention is usual, particularly in the epigastrium, and upon pressure one frequently elicits tenderness at a point just above and a little to the right of the umbilicus. Gurgling is occasionally found upon manipulation at this point. We have not been able to outline any diagnostic areas of tympany such as have been described by some authors. The patient is obviously nervous and the reflexes are usually over-active.

In order to detect radiographically factors that produce symptoms it is highly advisable to outline the duodenum in its entirety. In the hypersthenic and sthenic types it usually falls into view, but duodenal stasis is unusual in these types. In the hyposthenic and asthenic types, in which duodenal stasis is common, the third portion of the duodenum usually lies behind the stomach.

Various ingenious methods have been devised for visualizing the duodenum in these types, one of which was to obstruct the distal segment of the duodenum by a balloon attached to a duodenal tube, then injecting barium

into the proximal duodenum through this tube. This method is not advisable because of the distressing symptoms produced. The motility of the duodenum is often disturbed, barium being at times regurgitated into the stomach. The findings as a rule are misleading. Case has suggested that the duodenum can be visualized fluoroscopically by compressing the duodeno-jejunal junction against the spine with one hand and forcing barium through the pylorus with the other and examining in the first (R) oblique position.

These methods have advantages in eliminating or demonstrating the presence of certain organic lesions of the duodenum but are of little value in the diagnosis of duodenal stasis in most instances because the motility is disturbed and it is upon this that the diagnosis largely rests.

*Method of Examination and Radiographic Signs.*—We have developed a routine that all patients who give a clinical history suggestive of duodenal stasis be studied both fluoroscopically and radiographically in the vertical and prone positions, more emphasis being placed on the vertical position and the fluoroscopic observations.

The entire duodenum is kept in mind as a possible location or seat of the symptoms complained of, not only its contour but more especially its function, its disturbed motility being the first important diagnostic sign. Fluoroscopists generally have been trained to examine the stomach and cap with great accuracy but the second and third portions of the duodenum do not enter their field of observation unless some very pronounced, constant defect is present, such as a diverticulum.

The duodenum can be visualized routinely in most cases by forcing a small quantity of barium through the pylorus into the duodenum after one or two swallows of a barium meal has been given. The pylorus is usually taken by surprise and the barium can be seen to course through the duodenum in normal fashion. This same procedure is again repeated at the usual four-hour examination, forcing the small quantity of barium that may be left in the stomach into the duodenum. If the stomach and duodenum are empty allow the patient to take a couple of swallows more of a motor meal and re-examine the duodenum. Then refill the stomach and note the tone and motility of both the stomach and duodenum. This four-hour observation appears to be the more informative of the two. If the duodenum is normal a more uniform rhythm is present as a rule; if abnormal, the disturbance is more likely to be detected at this time not only by the disturbed motility but by the poor tone or atony which may represent a failing compensation. In advanced cases atony of the stomach is a frequent observation at this examination.

This routine was arranged especially for ambulatory patients which probably covers 95 per cent. of this group. A hospital patient remaining in bed would be unlikely to show many positive findings unless the obstruction was more complete or of longer duration.

Partial obstruction of the first or second portions of the duodenum due to adhesions or bands produces various deformities of the cap and may be

difficult to differentiate from ulcer or gall-bladder disease. However, when the combined screen and film examination is carried out, as given above, in combination with the Graham test* one is able to study the gall-bladder function in relation to that of the duodenum.

In congenital bands or so-called duodenal fixations, the cap may be constricted and pulled either to the right or left, the right being more common. But usually the cap is large and fills poorly, more particularly on the lesser curvature near the apex. The apex may appear pinched or constricted making the cap discharge its load with difficulty and it usually does not empty more than half of its content. The angle at the first and second portion of the duodenum may appear as a two-peak effect and shows little or no change from the prone to the vertical position. On assuming this position the stomach descends varying distances, placing traction on the cap, elongating it, and accentuating the angle at the junction with the second portion of the duodenum.

In these large flabby caps, where partially empty, the base on the greater curvature may fall in such a position as to give the impression of a duodenal diverticulum, so-called false diverticulum, and an erroneous diagnosis of ulcer may be made from the films.

The second portion of the duodenum will frequently be seen to form a straight line with the liver edge, producing a wide loop to the right of the stomach. The lumen may appear constricted and irregular. It may be sufficiently narrowed so that at times the emptying of the stomach may be interfered with. Occasionally when the second portion of the duodenum is adherent to the liver edge a sharp angulation may result from the fixed upper and the free lower portions. Obstruction involving the distal portion of the second segment is occasionally seen in stenosis secondary to ulcer. This condition is best differentiated from extrinsic pressure by not being influenced by posture and is usually seen as a constant defect.

The constant presence of gas in the second or third portions of the duodenum at the three-hour, six-hour, twenty-four-hour, and forty-eight-hour examination or in flat plates of the abdomen is of some diagnostic significance.

Obstruction involving the third portion is usually due either to pressure from the superior mesenteric vessels or an obstructing angle at the ligament of Treitz. This can best be demonstrated fluoroscopically by the above described technic, observing frequent or a continual interruption of the peristaltic rush through these segments producing an abnormal puddling and cradling of barium in the dependent loop. If due to extrinsic pressure the obstruction is usually relieved when in the prone position. This observation cannot be made with any degree of certainty from the films alone. The puddling and cradling in the minor cases may be interpreted as a peristaltic

* A few preliminary plates of the gall-bladder region may be made, the gall-bladder dye having been given the evening before. Follow by giving the barium meal to which a litle cream has been added.

wave that would normally pass into the jejunum. If the films are made in the prone position they are usually non-informative due to pressure defects.

If a greater degree of obstruction is present the dilated duodenum with wide transverse enteric markings may be seen at the three- or six-hour examination. Retention of barium in the duodenum at the six-hour examination is rare in contrast to the other diagnostic signs. This time-honored sign, while of great significance as far as the stomach is concerned, has been responsible frequently for the oversight of abnormal duodenal function.

As to difficulty of diagnosis the following case may be cited.

A girl of twenty-one was admitted in 1924. She had never been well: headache almost every day, slight rise of temperature almost daily for last five years. Subject to respiratory infections, colitis, dysmenorrhœa. For three years attacks of severe cramp-like abdominal pains lasting five to six hours. With the cramps tympanitis and headaches.

She consulted almost every prospect in this country and abroad, being practically bedridden for about five years as result of asthenia and headaches.

X-ray showed the second portion of duodenum distended and "writhing" with reverse peristalsis and puddling.

The interesting feature of the case is that no one thought of the duodenum. Finally Dr. Benjamin Michailovsky recognized the condition as shown in the plates which everyone had viewed but no one had attached importance to. He advised operation but the writer counselled "more evidence." Within a few days typical gastric tetany developed. Duodeno-jejunostomy was performed. The result has been admirable.

As to repeated operations. (H. T.) Admitted 1926. Woman thirty years of age. Chief complaint vomiting for five months. Three years ago had convulsions; twice in a sanitarium for three years. Has had respiratory infections, palpitation, dyspnœa, constipation and loss of weight. Five months before admission there occurred an attack of severe vomiting lasting three days, with loss of sixteen pounds. Since then has vomited once or twice daily. No pain, but sense of pressure in lower right quadrant.

Appendectomy performed. She continued to vomit daily until daily lavage was instituted. Readmitted one year later. The symptoms had continued; nausea, vomiting, flatulence, abdominal distress. Exploratory: duodenum held high by very dense adhesions. These were freed so as to mobilize and depress angle of duodenum.

Symptoms continued in spite of constant and careful medical treatment. Two years later re-admitted. X-rays showed duodenal stasis: duodeno-jejunostomy resulted in cure of digestive complaints.

*Treatment.*—We wish to state emphatically that it is not necessary or wise to operate upon every patient who suffers with duodenal stasis. We have previously expressed the view that temporary loss of tone with impairment of function in the duodenum is not uncommon and it is our experience that some patients with fairly long-standing histories may be relieved of their symptoms and restored to health. However, the longer the history of indigestion and the more severe the loss of flesh and strength the less probability of relief without operation. Also, those who have had painful attacks seldom improve materially without operation.

The decision whether to advise operation demands most careful consideration and cannot be made without taking into account the nervous and psychic state as well as the physical. No set rules should be followed. Probably no

patient should be subjected to operation before a medical régime has been given a thorough trial. However, most of our patients had already tried a variety of cures and diets without satisfactory or permanent improvement.

The factors which make us incline toward advising operation are (*a*) uncontrolled indigestion for many years, (*b*) progressive loss of weight and strength, (*c*) pronounced dilation and stasis in the duodenum demonstrated by X-ray examinations, (*d*) progressive psychoneurosis which followed the onset of symptoms, and (*e*) young patients. In the younger patients we are more inclined to advise operation with less severe symptoms and less marked stasis than in older patients because we believe that otherwise they will probably suffer progressive impairment of health and usefulness and because the results are prompt and satisfactory. The cases with profound psychoneuroses offer a particularly difficult problem. Here the family history, the environment and the psychic pattern of the patient have to be studied and evaluated in relation to the digestive system. In many instances we have been presented with clear histories of the development of nervous symptoms long after the onset of indigestion and we regard this as an indication for operation as the first step in effecting a cure. Most of these cases spontaneously regain stable nervous systems but a few require psychical reëducation.

The principles underlying medical treatment are to reduce the functional burden of the duodenum as much as possible and to improve the physical and nervous tone of the patient. Small feedings at frequent intervals, and rest, particularly after eating, are fundamental. It is often best to put the patient in bed for a few weeks; active exercise after meals must certainly be interdicted. The diet should be smooth without roughage or condiments and must be prescribed with due regard to the vitamin and caloric needs of the patient. A hot moist compress over the upper abdomen after eating is helpful in reducing the irritability and spasm of the duodenum. Retention enemas of mineral oil are preferable to carthartics where needed. Alcohol and tobacco are both harmful. Freedom from cares, worry and excitement must be secured as far as possible. After a few weeks of a rest régime the patient should begin to exercise, gradually increasing the duration and severity. Massage may be helpful and fresh air and sunshine are essential.

For further sedative and antispasmodic effect we commonly prescribe phenobarbital and atropine, sometimes wtih a digestive ferment, in capsules to be taken several times daily. Insulin has been given twice a day before eating in a few cases. This has always resulted in considerable gain in weight but it has relieved the indigestion little if at all. One of our patients gained twelve pounds during two months of continuous treatment with insulin and subsequent X-ray examination showed distinct improvement in the tone of the duodenum with less stasis, but her indigestion continues.

It has been our experience that the only cases that have been distinctly helped by medical treatment are the few with short histories of indigestion and very moderate degrees of stasis as demonstrated by X-ray study.

*Surgical Treatment.*—Bands or constricting adhesions should be freed.

Duodeno-jejunostomy is indicated for obstruction at the terminal portion of the duodenum. The operation is safe and the results good. Pool has done eleven cases. They have been carefully selected as is suggested by the fact that they cover nine years. The results have been satisfactory; seven excellent, two fair, two doubtful, no mortality. On the other hand, Niles[38] has a personal series of eighteen cases with six operated upon. Under conservative treatment in the non-operative cases the results were satisfactory. This suggests that in carefully observed cases operation is indicated in about one-third.

It is significant that all these cases have been in private practice. In a large public surgical service cases have been looked for for nine years and none found. The reason is undoubtedly that patients enter surgical wards only with fairly definite lesions and these cases remain in medical hands and are not recognized and referred. The number of our series is therefore small.

The details of duodeno-jejunostomy need not be given. The technic of the procedure is outlined in the report of cases.

*Conclusions.*—Chronic duodenal stasis caused by intermittent obstruction at or near the duodeno-jejunal junction definitely occurs. The clinical picture is suggestive.

There is a long gastric history. A significant feature is a feeling of fullness or pressure in the epigastrium after meals culminating in nausea. Actual pain at times occurs, vomiting is infrequent. These symptoms occur either in sharp attacks at intervals or are progressive for long periods. There is a periodicity in many of these cases which is dependent upon emotional disturbances or fatigue. A striking general feature is loss of weight and asthenia. Many of the patients are markedly thin and have had repeated abdominal operations. Usually there is tenderness in the epigastrium to the right of the mid-line.

In addition to the above there are usually toxic symptoms which include fever, headache, neuralgia, mental depression, cold extremities, skin eruptions as acne. The patients invariably develop instability of the sympathetic nervous system and if unrelieved often become psychoneurotic. Usually the cases have had one or more operations; appendectomy almost always, frequently freeing of adhesions or bands, cholecystectomy or gastroenterostomy. Ultimately some one centres attention on the duodenum. However, the diagnosis is not simple. Reliance must be placed largely on the fluoroscopical findings, though study of X-ray plates aids. The fluoroscopist must be experienced with the condition. Usually operation should be elected only after several X-ray checks, preferably by different observers. The findings at operation are often not conclusive, as the duodenum may be collapsed at the time.

No patient should be subjected to operation before a medical régime has been given a thorough trial. This failing, duodeno-jejunostomy may be elected. About one-third of the cases present striking indications for operation and show proportionate improvement after duodeno-jejunostomy.

Since the diagnosis of duodenal stasis is made upon symptoms and signs of abnormal physiology without directly demonstrating an organic lesion it requires the most careful coördination of findings by the internist, röntgenologist and surgeon.

CASE REPORTS OF DUODENO-JEJUNOSTOMY

CASE I.—*Duodeno-jejunostomy; adhesions necessitating secondary operation: cure.* A single white woman twenty-one years of age admitted to New York Hospital, October 8, 1924, with chief complaint of headache and dysmenorrhœa since onset of menstruation at age of fourteen. She has never been well. Headache almost every day, erratic temperature past five years 99–101.5. Dysmenorrhœa marked. A fairly well developed and nourished white female not acutely ill. Examination essentially negative.

October, 1924, D. and C. Uterus sharply anteflexed at internal os. Appendix with kink in lower third removed. Uterus found sharply anteflexed but tending to fall back-

FIG. 1.—(Case I.) Dilated duodenum.

FIG. 2.—(Case I.) Two-hour retention in duodenum.

ward. Right ovary presented a cyst about three-quarters inch in diameter; excised. Round ligament and peritoneum imbricated in order to support uterus in more anterior position.

October 18, 1927. Patient again admitted to the New York Hospital. Six months after operation patient had an attack of mucous colitis. Seen by numerous men. Colon irrigations, starvation diet, emetin, icthyol enemas, milk diet. In December, 1926, a polyp was removed from right antrum. (Figs. 1 and 2.)

Following attacks of mucous colitis has had attacks of severe cramp-like abdominal pains lasting at times five to six hours. With cramps tympanites and headaches.

Physical examination negative. *Barium series showed a normal stomach and normal first portion of duodenum. The second portion of duodenum was distended with "writhing" and reversed peristalsis. Hourly films showed stomach emptying normally but with definite puddling in the second portion of the duodenum.*

*December 1, 1927, patient again admitted after having spent the intervening time in bed at home. Symptoms having progressively become more marked.*

Attack of typical tetany. December 2, 1927, operation through an incision to right

of mid-line was done. Transverse colon lifted and duodenum found considerably enlarged. The superior mesenteric vessels fell down over the duodenum almost like a heavy band which was undoubtedly the cause of the obstruction. Few nodes in retroperitoneal region. A duodeno-jejunostomy was performed between the jejunum, about four inches from the angle, and duodenum just to the right of the superior mesenteric vessels, the opening being about one and one-half inches long. Two layers of chromic anteriorly and also posteriorly. Convalescence uneventful. Patient discharged on thirty-seventh post-operative day (January 8, 1928).

February 23, 1928, patient again admitted. Following operation she was entirely relieved of the symptoms which had lasted ten to twelve years. One week before admission noticed a slight tingling in her hands. This gradually grew worse until she had actual spasms of her hands and feet. Tetany. Attacks came on about two hours after meals with distress in epigastrium, distention, rapid and shallow respiration, tingling of hands and feet, followed by spasms of hands and feet.

Physical examination same as before with recent scar and slight distention in left side of upper abdomen.

Barium series showed slight distention of second and third portions of duodenum with very definite puddling in second portion at end of two and three hours. The duodeno-jejunostomy was not visualized clearly.

March 5, 1928, under ethylene-oxygen-ether anæsthesia, the former scar was excised.

Massive adhesions were found. Stomach and duodenum presented as a firm, hard mass, the result of very marked spasm in spite of fact that the patient was under anæsthesia. As the adhesions were freed, a loop of ileum quite collapsed wriggled out of a fossa formed by adhesions, the loop lying beneath the jejunum just distal to the site of the anastomosis. The jejunum was traced downward for some distance and found to be quite normal and no adhesions present. Adhesions then dissected so as to examine the anastomosis. The proximal portion of the jejunum was normal. The portion distal to the stoma was dilated. The stoma was dissected out in order to be quite sure of its patency. The jejunum was opened distal to the stoma and the finger introduced readily showing a wide open stoma. The finger passing up to and through the pyloric ring which was very firmly contracted and thickened. Incision closed by three rows of transverse sutures so as not to diminish the calibre of the vessel. All denuded areas were then covered with sterile vaseline. The pylorus was then incised longitudinally so as to divide the pyloric ring, and the opening repaired transversely, the idea being to prevent subsequent pylorospasm.

Convalescence uneventful and patient discharged on fiftieth post-operative day (April 24, 1928).

Present condition, five and one-half years after operation: weight 103; very little digestive disturbance if she observes a reasonable diet. Headaches far less frequent than formerly. Bowels regular. Very little abdominal discomfort. Complexion entirely clear; sleeps well. She adds (from Santa Barbara) "the duodeno-jejunostomy withstands even earthquakes."

Case II.—*Repeated operations before true condition was recognized: duodeno-jejunostomy: cure.* A white, unmarried female thirty years of age first admitted to the New York Hospital, September 9, 1926, with chief complaint, vomiting for past five months.

Five months before admission had attacks of vomiting which were so severe she was unable to keep any food down for days and lost sixteen pounds. Severe vomiting lasted three days; placed on Murphy drip and vomiting stopped to a certain extent. Has vomited once or twice a day since. No pain but sense of pressure as if from gas in right lower quadrant.

A thin woman. Slightly enlarged thyroid gland. A few constant râles at left apex posteriorly. Abdomen negative save for slight tenderness in right lower quadrant. Fine tremor of hands and exaggerated knee-jerks. X-ray showed a high fixation of the

duodenum. Operation for chronic appendicitis; an appendix four inches long with thick wall showing evidence of definite disease removed. She continued to vomit daily until daily lavage was started. Discharged on fifty-first post-operative day (November 2, 1926) still being lavaged.

Readmitted one year later with much the same symptoms all the time as before operation. Troubled by nausea, vomiting, flatulence and some pain in the abdomen. Pain frequently in region of appendectomy scar. Some burning pain recently over tenth rib posteriorly on right. Usually nauseated and vomits two hours after meals. Soda does not give any relief but vomiting relieves her. Has lost seven pounds in last four months.

Abdomen distended and tympanitic. Tenderness at right costal margin.

*Operation.*—Exploratory through high right rectus incision. Gall-bladder negative. Duodenum held high by very firm, dense adhesions. "The most dense I have seen in any case." These were freed so as to allow mobilization and a straight course and more dependent position of angle of duodenum. Transverse colon was inspected. Normal. No ulcer of duodenum or stomach.

Patient continued to vomit daily until discharged twenty-three days post-operative (February 16, 1928).

Admitted to New York Hospital for third time two years later (February 2, 1930), again without relief of symptoms. About one year ago vomited some small clots of blood. Has had a thorough treatment for ulcer (medically) but without improvement.

Physical examination essentially negative. Careful X-ray of gastro-intestinal tract revealed definite dilatation of the second and third portions of the duodenum with marked writhing, twisting and also some reverse peristalsis. Barium enema showed marked ptosis.

Admitted to New York Hospital for fourth time, March 2, 1930, for third operation. Condition as before. Still has occasional attacks of moderate pain in mid-line in epigastrium usually accompanied by vomiting of bile, this vomiting being prevented if lavage is done with onset of sense of nausea. Pain seems to be initiated by overeating more than anything else.

Physical examination negative. *Operation.*—Under ethylene-oxygen-ether anæsthesia a transverse incisision midway between umbilicus and ensiform and extending to outer borders of rectus made.

Stomach seemed normal. Many adhesions between gall-bladder and duodenum. The jejunum was located at its proximal end and there seemed to be a kink in it only a short distance beyond the ligament of Treitz. Duodeno-jejunostomy done with double row of chromic sutures posteriorly and anteriorly, the stoma admitting end of thumb.

Course smooth and discharged on twenty-fourth post-operative day (March 29, 1930).

Patient admitted again six months later, December 19, 1930, for pyelitis, having been exceptionally well in the interval.

*Results.*—"Since my operation of 1930 I have gained about twenty-two and one-half pounds and now weigh about 122½. My appetite is exceptionally good; I can eat everything and enjoy my meals. I am troubled with headaches and nausea only before my periods. I never have any abdominal discomfort; my general condition is greatly improved."

CASE III.—*A striking case in which the true condition was overlooked for fourteen years: duodeno-jejunostomy: cure.*

Male, aged fifty. The following series of operations and studies were with one exception carried out by prominent men in other cities.

1923, appendectomy, exploratory of the gall-bladder and duodenum. Gall-bladder slightly thickened, no adhesions, no stones. Not sufficient evidence for removal. Duodenum normal.

1926, Gastro-intestinal series. Stomach and bulb negative. Graham test very little dye in bladder. Two negative shadows present.

1930, gastro-intestinal series. Two gall-stones. Ptosis of stomach and colon. Five hours gastric retention. Definite evidence of colitis.

September 30, 1932. Doctor R. stated: "He has an obviously dilated stomach with no organic lesion that I could ascertain and a slight delay without dilatation of the terminal portion of the duodenum." Doctor M. gave gastro-intestinal series the following day which was reported negative for organic disease. (Figs. 3 and 4.)

*Present Illness.*—Onset fourteen years ago with epigastric discomfort after meals, belching and fullness in epigastrium. Symptoms have been intermittent until past six years and almost constant since. Best weight 178 pounds fourteen years ago. For past three to four years has taken three to four glasses of warm water on arising which induces vomiting. Has used stomach tube, which he carries, and uses two to three times a day to get relief. Has lost fifty pounds in weight. Feels weak. Appetite good but has distress after taking food. Afraid to eat. Feels mass in right upper quadrant after eating, belches almost continuously, frequent severe headaches, relieved on using stomach tube. Bowels regular. Friends tell him he looks badly. Doctors tell him the

FIG. 3.—(Case III.) Dilated duodenum.

FIG. 4.—(Case III.) Two-hour retention.

trouble is in his head. On several occasions has felt toxic. Temperature frequently 99.8° to 100°. Following castor oil always had fever, face swells and unable to close hands.

*Physical Examination.*—A poorly nourished white man of 120 pounds. Stomach and transverse colon low. Palpable fluctuating mass in right upper quadrant, at times mass is tympanitic. Test meal.—T.A. 80, F.A. 50. Occasional spurt of duodenal regurgitation. Blood-pressure, 100/60; pulse, 80; blood Wassermann, negative. May 16, 1932, X-ray and fluoroscopical show duodenal fixation with stasis in cap. Duodenal obstruction at angle of Treitz with marked duodenal stasis in third portion. Gall-stones. Above findings repeated three times.

Operation November 1, 1932: (1) Duodeno-jejunostomy for constricture at the duodeno-jejunal flexure. (Fig. 5.) (2) Cholecystectomy for cholelithiasis.

Avertin supplemented with ethylene and oxygen. (1) A right upper rectus incision was made, an old mid-right rectus incision scar being excised. There were many adhesions about the duodenum which were separated. *At the duodeno-jejunal flexure there was a definite constriction of the gut just beyond the ligament of Treitz, which seemed to be due to adhesions in this region. These were separated.* Duodeno-jejunostomy. (2)

The gall-bladder contained two large stones as had been demonstrated by X-ray; cholecystectomy. (Fig. 6.)

*Result.*—He has gained about fifteen pounds since discharged from the hospital and his symptoms are much improved, although he is living under very unfavorable conditions.

CASE IV.—*Marked duodenal stasis: one attack of tetany: anatomical anomalies: duodeno-jejunostomy: cure.* A white, married female twenty-eight years of age, first admitted to the New York Hospital, March 21, 1932, with chief complaint of attacks of abdominal pain with vomiting.

Stomach symptoms since removal of appendix sixteen years ago. Infrequent and

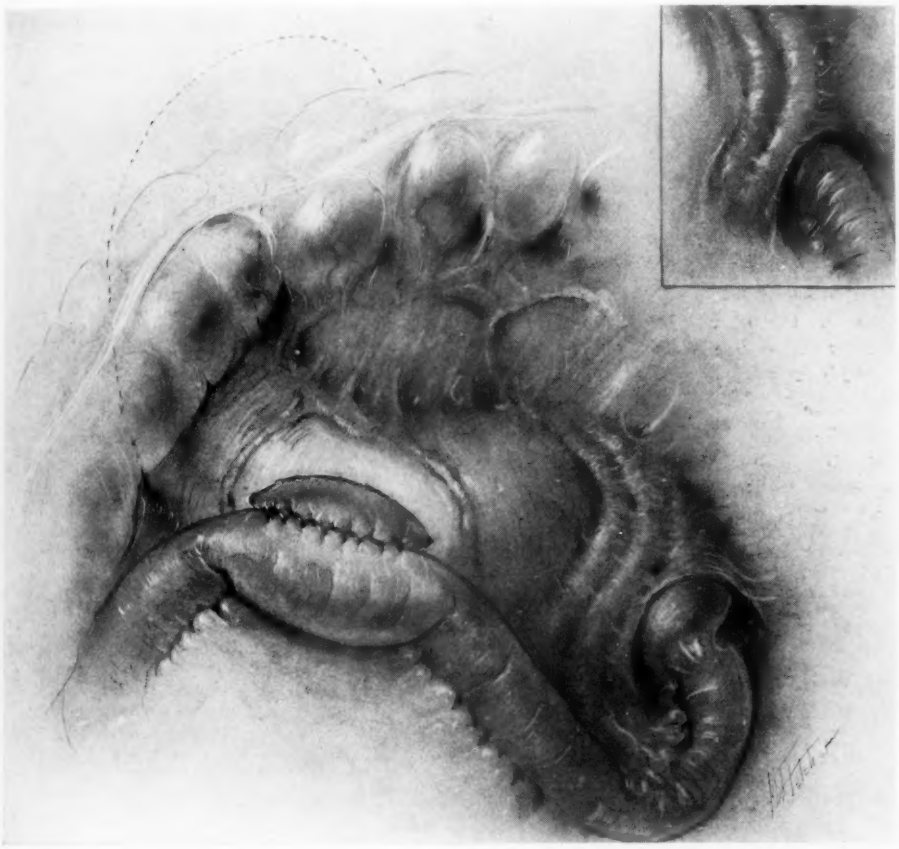

FIG. 5.—(Case III.) Obstruction at duodeno-jejunal junction showing sharp constriction as if a string had been tied loosely around the gut. (Insert: before traction on jejunum to demonstrate the obstruction.) First operative step, peritoneum divided; posterior serosal stitch between duodenum and *superior* surface (not free edge) of jejunum.

mild attacks. Worse since birth of first baby two years ago. Last attack very severe; pain radiated through to back. Attack of tetany in March. Has no warning of attacks. Does not think attacks depend upon character of food. Attacks of diarrhœa for past year independent of attacks of abdominal pain. Two or three liquid movements daily at times, alternating with normally formed stools. No alternate periods of constipation. Pain in abdomen is sometimes very severe. Vomits very often with attacks. Often notices food eaten several meals previous. Appetite good. No distress in intervals. No tenesmus. No blood or mucus in stools. Some loss of weight. Some loss of general strength. Sleeps well. No headaches. No thirst. No dysuria.

*Physical Examination.*—Weight, 103. Abdomen full. Somewhat enteroptotic. Well-

healed scar in appendicial region. Quite tender in right upper quadrant and epigastrium. Reflexes normal. Blood pressure 110/70.

X-ray examination October 10, 1932. (Fig. 7.) Stomach is transverse, fish-hook character, presenting no definite intrinsic pathological process. Duodenal cap is visualized, appears symmetrical and regular and emptied in the usual fashion. At the junction of the descending and transverse portion of the duodenum there was a marked angulation with puddling of the barium in this area, with a slight tendency to reverse peristalsis. The barium passed from this point with rather rapid intensity through the proximal loops of the jejunum in a suggestively irritable fashion. The patient examined in the supine

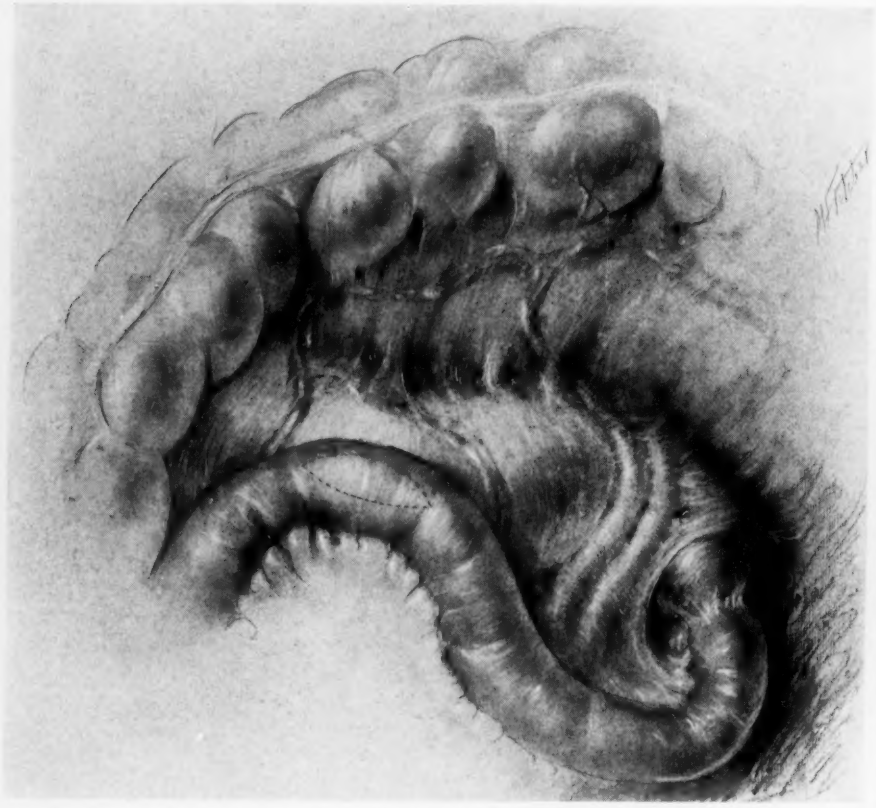

FIG. 6.—(Case III.) Situation of stoma after duodeno-jejunostomy.

position on the horizontal table showed a tendency to elevation of the distal third of the stomach and slightly outward and creating a curvature as though resting upon the pancreas, the exaggerated mucosal markings of the jejunum suggesting a moderate amount of irritability. At the end of four hours there is no gastric residue but the angulation in the duodenum above described still shows the retention of barium, and the head of the column is already in the rectum.

Similar findings by Doctor Holland in regard to stasis of duodenum.

Duodeno-jejunostomy for partial obstruction of the duodenum, October 18, 1932. Ethylene-oxygen. Right upper rectus incision, the duodenum was exposed and a good many adhesions found about it. These were separated. The first, second and third portions of the duodenum were markedly distended, the beginning of the jejunum being collapsed. The point of obstruction was definitely at the duodeno-jejunal junction.

Further examination revealed definite constriction of the duodenum as it passed through the base of the mesocolon. It was decided that a duodeno-jejunostomy was necessary. This was accomplished by drawing part of transverse duodenum through an opening in the transverse mesocolon.

The case presented several anatomical anomalies; the transverse portion of the duodenum was suspended from what could be readily called a short mesentery. There had been failure of the great omentum to fuse with the transverse colon, so that the transverse colon was lying free, there being no gastrocolic ligament.

This case represented a very definite obstruction of the duodenum, the duodenum

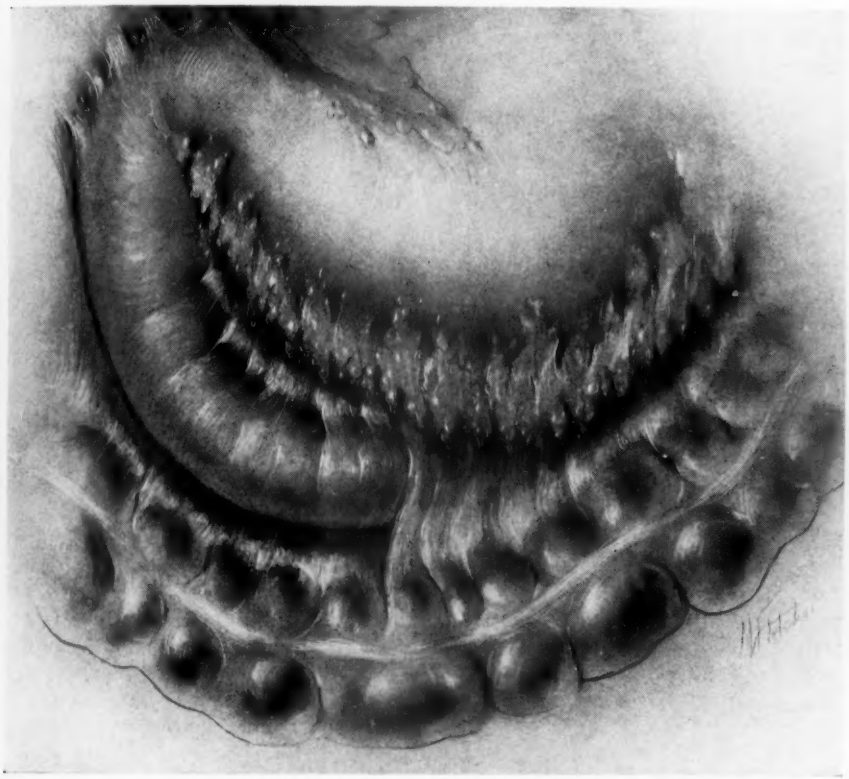

FIG. 7.—(Case IV.) Anomalous condition; no gastrocolic omentum; markedly distended duodenum.

being fully three times the calibre of the proximal jejunum. At the close of the operation, the jejunum had enlarged in size and the passage of gas was audible. (Figs. 8 and 9.)

*Result.*—April 2, 1933, no digestive disturbance at all; occasional headaches; bowels regular; occasionally some general abdominal discomfort; appetite good; feeling fine. She is still on a restricted diet.

CASE V.—A nineteen-year-old unmarried male admitted to the private side March 8, 1931, with chief complaint abdominal discomfort and nausea for past four months.

At age of eleven had convulsions which have recurred at about three-year intervals. Has been given luminal daily since. T. & A. as a child. In 1928, had an appendectomy, course uneventful. At one time he was said to have a "nervous heart." In 1930, during May, June and July, was jaundiced, which subsided under medical treatment. In 1930, had an attack of sinus accompanied by colds and headaches which gradually cleared up.

December 27, 1930, three months before admission, patient had gas pains, enema

returned with good results and much relief. The next day he had a recurrence with nausea. This continued for some time and Doctor Holland was consulted. Patient examined thoroughly, fluoroscoped and X-rayed. Given benefit of treatment with diet, supports and other means but to no avail. Reversed peristalsis having been observed, an operation was advised to find and relieve the cause.

Physical examination showed a well-developed and nourished male adult, with a point of tenderness over an old right rectus appendectomy scar, otherwise negative.

March 9, 1931, under ethylene-oxygen-ether anæsthesia, an upper right rectus incision was made.

Upon opening the abdomen the hepatic flexure of colon was found twisted on itself. Adhesion of omentum to appendix scar and a dilated duodenum.

Adhesions of omentum were severed. Hepatic flexure of colon then readily returned to normal position. Careful inspection of stomach, pylorus, liver and gall-bladder did

FIG. 8.—(Case IV.) Post-operative barium passes into jejunum without any accumulation in duodenum. This case was one of the two who had attack of tetany.

FIG. 9.—(Case VI.)

not reveal anything abnormal. The transverse colon was lifted and the transverse portion of the duodenum inspected and was found to be very definitely dilated. The cause of this could not be determined on account of the large vessels at the duodeno-jejunal junction, but there were no adhesions anywhere in this region. Probably the obstruction was due to the superior mesenteric vessels. An anastomosis seemed definitely indicated. Accordingly, the peritoneum over the duodenum was divided and this portion (transverse portion) of the duodenum mobilized. A suture anastomosis was made between the jejunum about five inches from the duodeno-jejunal junction to duodenum two inches from the duodeno-jejunal junction. Fine linen was used for the external layer. Chromic for the internal suture. The orifice was about two centimetres long. The wound was carefully closed in layers without drainage.

Following operation temperature went to 101°, by rectum, came down gradually. Remainder of course uneventful, and patient discharged from hospital on nineteenth post-operative day.

April, 1933, he is reported as in good condition and free from symptoms.

CASE VI.—A white married female, aged twenty-eight, admitted to the New York

Hospital October, 1930. July 18, 1929, chief complaints were pain in the joints, pain in the right side of chest, nausea, vomiting and fatigue. Ruptured appendix removed five years ago.

*Present Illness.*—Two weeks previous began to have pain in the smaller joints of the right hand and ring finger. Had some pains in knees but no swelling. Has had no sore throats. So-called pleurisy eight years ago. Repeated attacks of nausea and vomiting, pains in left chest with temperature. Suspected gall-bladder some years ago which X-ray showed to be enlarged. Repeatedly has had attacks of hives.

Latter part of 1929 had an attack of so-called pleurisy. X-ray of chest did not show any evidence of tuberculosis, but because of constant recurring pain, it was thought best for her to live out of town. After leaving City she had a continuance of her symptoms followed by psychoneurotic breakdown which confined her to a sanatorium for several months.

She passed under the observation and care of various men. October, 1930, as patient did not improve rapidly, she saw a psychologist who advised removal from the institution and sent her home under care of a nurse. Patient did not improve under this change. October 10, again consulted Doctor Niles, complaining of stiffness and body soreness, also pain in the occipital region, and difficulty in swallowing. Had been running a temperature.

Physical examination revealed extensive superficial acne of face; pupils dilated and react promptly, tongue heavily coated, moderate fine tremor; neck shows several palpable nodes in the left posterior triangle; tenderness over occipital region; tender over neck; heart accelerated; no murmurs; lungs negative; abdomen, there is a point of sharply localized tenderness just to the right and below the umbilicus; reflexes hyperactive. Weight, 130 pounds. Temperature, 100°.

October, 1930, confined to hospital where she continued to run a temperature varying between 100° and 101°. X-ray examination showed dilatation of the second and third portions of the duodenum with reverse peristalsis. (Doctor Martin.) The same findings reported by Doctor Holland.

October 28, 1930, operation. The findings of a distended duodenum bore out the clinical diagnosis. A duodeno-jejunostomy was performed anastomosing the jejunum four inches from the angle to the third portion of the duodenum just lateral to the mesenteric vessels. The duodenal site of the anastomosis was prepared by dividing the peritoneum transversely and carefully mobilizing the duodenum from the posterior wall and the lower border of the pancreas which was clearly visualized. When the peritoneum over the duodenum was divided, the duodenal distension became even more apparent.

Immediately after operation patient seemed to improve a good deal. Had temperature for a few days which soon subsided. Patient complained of discomfort from pains in her head and neck. Her intestinal symptoms improved. No temperature. Gained in weight but still complained of good deal of pain in side of her head and neck. This condition was relieved almost completely by drainage of her sphenoidal sinus by Doctor Harper.

At different times since her operation she has had some abdominal complaint of pain and occasional attacks of vomiting which last as long as a week. Her general condition, however, has been most satisfactory, in as much as her weight has steadily increased, and the condition of her skin has improved very much.

The latter part of December, 1932, had an attack of vomiting which lasted for three weeks. There were no signs of obstruction so far as the character of vomitus or general condition were concerned. She was given a barium meal the latter part of January during an intermittence in her vomiting attacks, and the only abnormality made out at that time was increased motility, the meal being present in the rectum within six hours. After this attack she improved and has been able to eat without nausea. There has been an increase of weight to 137 pounds.

CASE VII.—Under observation since 1927, Doctor Cussler writes as follows:

Miss —— first consulted me in June, 1932. She complained that she tired easily and had some headache, which came on at intervals, frequently lasted several days, and was accompanied by soreness over the eyes and a feeling of nausea. This nausea was not active, but gave her a sensation of uncertainty. She also had intermittent attacks of pain in the right lower quadrant of the abdomen with a sense of soreness and fullness. These symptoms have been present at intervals since 1926. She was habitually constipated and the usual laxatives, mineral oil, *etc.*, were ineffective. She stated that she had no desire for food.

X-rays taken in 1927 and brought to the office with her showed a marked visceroptosis with dilatation of the duodenum. She had already consulted a number of physicians without receiving much help.

Physical examination was essentially negative. The blood-pressure was rather low, 105/65. Hæmoglobin, 75 per cent., with a corresponding number of red cells. Weight, 141 pounds. Heart and lungs negative.

There was slight tenderness in the right lower quadrant of the abdomen. No muscle spasm. Distinct fullness was present in the left lower quadrant, and the descending colon was felt.

She was given advice regarding diet and mechanical laxatives were suggested. A binder to correct the visceroptosis was ordered.

For a time she felt better and during the Summer remained fairly well.

In December, 1932, she returned to the office, and reported that during the Fall the symptoms had recurred. Her habits of eating and living were irregular.

Gastric analysis shows no free hydrochloric acid before or after meal. Stool negative for blood or parasites. Gastric analysis after histamine (thirty-five minutes) shows free hydrochloric acid 9. Basal metabolism 17.6.

*X-ray.*—Stomach well filled, hypotonic, large vertical, extending to brim of pelvis. Peristalsis fairly normal character. No gastric defects. Duodenal bulb visualized, rather low, elongated and fixed at tip in upright position. The descending duodenum is definitely on the stretch, narrow and at the beginning of the transverse portion of the duodenum there is a definite distension and puddling with reverse peristalsis occurring from the ligament of Treitz backwards and upwards in the duodenal bulb. Distal to the ligament there is a moderate dilatation of the jejunum and localized spastic areas more or less persistent, simulating bands which are probably referred from the above described duodenum. The proximal portion of the duodenum is persistently dilated and presents stasis throughout the examination. Twenty-four-hour plate showed barium in sigmoid, appendix visualized low in pelvis, redundant and tortuous and slightly fixed. Palpation for tenderness shows this essentially above region of appendix and over descending colon just above sigmoid. Pressure at this second point causes pain referred to right side of abdomen. Impression—a band in the region of the tip of the duodenal bulb with fixation to the under surface of the liver in the region of the gall-bladder and angulation defect at the ligament of Treitz, creating duodenal stasis and referred spasm to the proximal jejunal loops. (Kilbane.) Barium enema shows irritable colon.

*Operation.*—January 20, 1933. A right rectus incision. The appendix removed. There were a few adhesions around the descending and first portion of duodenum. The descending and horizontal portions of the duodenum were seen to be dilated to a moderate extent. The duodenum was difficult to deliver for some unexplained reason and the anastomosis was difficult throughout due to the poor exposure of the loop. Duodeno-jejunostomy was performed. Apart from a wound infection she did well. The result to date has been excellent.

CASE VIII.—A white married female forty years of age, November 7, 1929, complained of vomiting in the morning, no appetite, numbness of legs. Alcohol consumption one quart a day. Six months previous to this she had a history of fever, some bloating and vomiting. The fever lasted about four days, and the gastro-intestinal symptoms about

two weeks. She got along very well from November until she went abroad in the Spring of 1930, having been off alcohol during this time. When she got to southern France, she had what she described as the "flu" with temperature three or four days, with vomiting and bloating. Could keep nothing on her stomach but brandy. In August, 1930, when she was very thin, had no appetite, with some vomiting at this time. Summary of the gastro-intestinal series showed no evidence of ulcer or cancer; stomach of vertical type with definite evidence of obstruction at the angle of Treitz as indicated by distension and reversed peristalsis in the descending loop of the duodenum; appendix not visualized; redundancy of the sigmoid; cardiac and pulmonary shadows, normal; small shadow in the lower right abdomen probably representing a calcified node. She was put on a diet with more rest and less alcohol. (Figs. 10 and 11.)

In October she was under the care of a neurologist. X-rays of the gall-bladder failed to show any shadow of bladder or stone. Stomach was normal, as was the duodenal bulb. Second and third portions of the duodenum were distended and constantly

FIG. 10.—(Case VIII.)

FIG. 11.—(Case X.)

filled throughout the series. The findings were significant of duodenal stasis which appeared to be due to partial obstruction of the duodenal-jejunal junction. She was put to bed for two months on a high caloric bland diet; gained some weight but decided if she had to be operated on at any time, she did not want to waste any more time in bed.

*Operation.*—December 31, 1930, duodeno-jejunostomy for chronic duodenal obstruction. The first portion of the duodenum just beyond the pylorus presented one firm peritoneal band running across its anterior surface. Beyond this the duodenum was enlarged, this enlargement continuing to the duodeno-jejunal juncture. The obstruction to the duodenum was caused by the superior mesentery vessels. The right lower quadrant was explored. No adhesions encountered. In the left lower quadrant there were two adhesions of the omentum to the anterior abdominal wall. Exploration of the duodenum and the obstruction to the duodenum noted.

She got along until May, 1931, when she went to Bermuda. On the way home she was seasick, and continued vomiting for two weeks. Since that time she has had no spells of vomiting where it was necessary to go to bed, merely losing a meal occasionally. Her weight has remained around 118 to 125, and her consumption of alcohol has continued entirely too much.

Her medical attendant writes: "The result seems to be excellent."

CASE IX.—*Duodeno-jejunostomy: only temporary benefit.* Case report presenting comparison between surgical and medical treatment.

A white single female twenty-one years of age admitted to private side of New York Hospital, January 22, 1928, because of heartburn and "lump" in epigastrium after meals for past three years.

T. and A. twelve years ago. D. and C. ten and eight years ago for dysmenorrhœa. Eighteen months ago had repeated attacks of dizziness. These lasted for one year, during which time gall-bladder drainage was done five to six times. Until three years ago patient enjoyed relatively good health provided she was careful with her diet. About that time onset of heartburn and heaviness in epigastrium, lassitude and vomiting; patient lost twenty pounds within a few months.

Two and one-half years ago had influenza and since then has been troubled with mucous colitis. During last six months epigastric pain has become marked even when on strict diet.

Physical examination showed a rather thin adult female not acutely ill.

Doctor Holland reports: "Fluoroscopical examination showed the stomach quite normal except perhaps a little low in tone. The duodenal bulb at first seemed to be somewhat defective but the defect was not characteristic of ulcer. There was a very definite stasis at the angle between the second and third portions of the duodenum and with reverse peristalsis.

January 23, 1928, under ethylene-oxygen-ether anæsthesia the abdomen was opened.

Appendix was movable two and one-half inches in length, small calibre with a thickened wall. Gall-bladder had some adhesions to omentum; freed. The duodenum was fixed somewhat high, and bands from gall-bladder to duodenum and across it to colon were freed. No ulcer felt in stomach or duodenum.

The transverse colon was lifted and the duodenum beneath the transverse mesocolon was dilated. It seemed wise to do a jejuno-jejunostomy.

She reported in March of that year much improvement; had gained ten pounds. In July her weight was 127, it was 115 when she first came. She was experiencing some upper abdominal distress, more of a burning sensation, and her bowels had not been functioning properly and she had taken no exercise.

Course uneventful following operation and discharged on eighteenth postoperative day.

The last fluoroscopical examination made December 31, 1931, showed the anastomosis at this time. The patient had complained of some slight distress one or two hours after meals without alkaline relief; of some slight regurgitation of tasteless material, but no actual vomiting. Bowels fairly regular with agar.

Last Fall she stated that she was feeling well except for occasional upsets.

Doctor Holland states: "It is interesting that her sister had been to see me two years previously, complaining of practically the same set of symptoms except that it had extended back for a long period. She had never been really well since suffering an attack of influenza in 1916. She began to experience nausea and headaches occurring in attacks. Some epigastric discomfort, occasionally quite severe. There was some slight food and soda relief, but this was not marked. Most of the trouble seemed to be an epigastric pressure occurring soon after eating. It seemed to have no relation to the kind of food. With the attacks of nausea there was some vertigo. These attacks usually lasted from a week to ten days and very often followed the menstrual period of four or five days, but they did occur at other times as well. She was intolerant of sea food, this caused violent cramps at times. Aromatic foods, such as onions, she would taste for over twenty-four hours. She had always been constipated but also had attacks of diarrhœa, very often associated with the nausea and headache.

"Fluoroscopical examination showed a normal stomach except for slight lack of

tone; a normal duodenal bulb; a very definite stasis at the angle between the second and third portions of the duodenum with reverse peristalsis.

"She was placed on a conservative plan; a soft, frequent-feeding diet, and much rest; she was given a Van Norden corset which incorporated a spring truss. She has reported from time to time improvement. She gained seven pounds the first two years of this treatment, but she had recurrences of her indigestion from time to time. In 1929, after returning from a European trip, which was probably more or less strenuous, she suffered a recurrence of the nausea, vertigo and epigastric distress. The fluoroscopical findings at this time were very much the same except that there was apparently more of a constriction than was formerly noticed in the second portion of the duodenum. This attack soon passed, however, and she has been fairly well since that time, but never entirely well. A course of abdominal pumping exercises seemed to help considerably.

"I heard directly from her last in 1930, but her sister has reported that she is feeling fairly well.

"It is interesting to compare these two cases as the patients are of the same habitus and approximately the same height. They live under the same physical and social conditions and are temperamentally very much alike.

"I am inclined to think that the one treated surgically has done a little better than the other one. Miss Ann is thankful that she had the operation performed and Miss Elizabeth is glad that she did not have an operation."

Case X.—Female, single, aged twenty-four. *Chief Complaints.*—Cramps in upper abdomen, dizziness, nausea, weakness. *Past History.*—Was a sickly baby and difficult to feed. At five became well nourished and continued healthy until about sixteen when she weighed 116 pounds, her maximum weight. Menstruation onset at thirteen, regular, little pain, moderate flow for five days.

Present symptoms began at twelve when she first began to have waves of nausea and occasional attacks of mild epigastric pain. Since then has fullness and bloating immediately after meals, especially after large meals. Is more comfortable if she lies down after eating. Has eructations of gas and rumbling for one hour after meals. Often has waves of nausea but has seldom vomited. Bowels always constipated.

In May, 1930, was operated upon for calcified mesenteric nodes which were located near the mid-line at the level of the fifth lumbar vertebra. The appendix was also removed.

In August, 1930, had an attack of severe epigastric pain with vomiting. Was taken to a hospital where intestinal obstruction was suspected. The attack subsided after three days and there has been no severe recurrence though she has had many mild attacks of pain but no vomiting. They occur once a week or oftener and last from five to thirty minutes. They may come on at any time of the day, never at night, most often in early forenoon. She has gradually lost weight, has become more easily fatigued and her mother says that she has gotten nervous and more difficult, especially in the past six months. She has had persistent acne which has resisted all treatment. Never had fever. *Physical Examination.*—A slender girl with firm muscles. Weight, ninety-four pounds. Moderate acne on face and back. Upon pressure just above and to the right of the umbilicus there is tenderness and fine gurgling.

X-ray examination showed a vertical stomach, slightly hypertonic, normal size and good position. The pylorus was normal. The cap was normal in size and filled satisfactorily. The second portion of the duodenum made a wide swing to the right, producing the figure 4. It is fixed and lies on a level with the transverse process of the fifth lumbar segment both in the vertical and the prone positions. There was considerable stasis in the third portion of the duodenum with cradling. This was as marked in the prone position as in the vertical.

After four months of modified exercise, rest, diet, *etc.*, patient was re-examined and no change was noted in the duodenum. Her weight was unchanged.

In this case the history of difficult feeding in infancy, and in adolescence having

indigestion is characteristic of congenital fixation of the duodenum. Dilatation of the third portion probably did not develop until after the operation for removal of calcified lymph-nodes and appendectomy.

January 12, 1933. Duodeno-jejunostomy. Divisions of adhesions. The first portion of the duodenum presented a high fixation and angulation due to a band of adhesions, apparently inflammatory, attaching it to the liver. These were freed and the angle of duodenum depressed. The transverse portion of duodenum showed marked distention. Adhesions of omentum to abdominal wall were freed.

*Result.*—April. The patient is doing well and gaining weight.

CASE XI.—Female, aged forty-three, single. Graduate nurse. Was unusually healthy and well nourished until the age of fifteen when she was sick for almost one year with stomachache and a low fever. Appendix was removed during this illness, but it was not acutely inflamed, and convalescence was prolonged. Eventually recovered and subsequently stood a three-year hospital training in nursing without a day's illness. At thirty she went to China and worked hard in a Mission Hospital for the next six years. At thirty-four she suffered with backache, fatigue and dysmenorrhœa. Disease of the right ovary was diagnosed and she was operated upon but the ovary was normal and nothing was done.

Patient dates her present illness from the age of thirty-five, when she began to have indigestion. Her bowels were normal until two years previous to that date when the movements began to be soft and since then she has usually two to four loose movements daily, mostly in the morning. She never had acute diarrhœa. At thirty-six an exploratory laparotomy was done which she reports revealed that her liver was shrunken and that something was wrong with her colon. Nothing was done. At thirty-nine a diagnosis of sprue was considered and she was treated for it. She has never been seriously anæmic.

Menstruation, onset at thirteen; regular, pain for the first two days. Flow always scanty. Duration four days. Weight. At twenty she weighed about 130; at thirty-five about 120. During the past five years has averaged 103. Present weight 95 pounds.

Patient has spent several months in various hospitals and her digestive tract has been X-rayed four times without finding any organic condition.

Within a few minutes after eating the patient feels "heavy and stiff in the pit of her stomach." This is often followed by nausea but she has vomited seldom. She soon feels gas in her stomach and begins to belch, frequently having severe, noisy attacks. Her upper abdomen becomes hard and distended. She frequently suffers with attacks of pain which she locates in her right hypochondrium and which is felt in the right side of her back and chest up to her neck. The pain is severe but never has required morphine. For seven years her tongue has been dry and it burns. She feels weak and gone and is afraid to eat because of the distress which follows. She sleeps well if she has no pain but often wakens at four or five A.M. with gas. She never has headache and has had no eruptions of the skin.

The patient has been studied exhaustively and carefully treated. Insulin has been given and food elimination diets have been followed without material improvement.

Her mental reactions were very interesting, her neurosis being deep and fixed. She was obsessed with ideas of serious organic disease, at times feeling that her liver was really shrunken. Again she believed that she must have some disease of her pancreas and at other times was convinced that she had contracted syphilis while in the Orient. She was well educated and intelligent but dressed like a child. A psychiatrist reported as follows: "She has a schizoid type of personality but certainly shows no evidence of having any schizoid psychotic reactions. She is an apprehensive, sensitive individual who, I believe, finding that she must no longer exert herself since she and her family are now in a comfortable position financially, has regressed into an infantile and rather fixed psychoneurotic reaction."

*Physical Examination.*—Height, sixty-six inches. Weight, ninety-five pounds. Skin is deeply pigmented, giving the appearance of tanning from the sun. This was not

increased in the flexures or about the eyes and the visible mucous membranes showed no pigmentation. Blood-pressure, 124-80. Heart, lungs, extremities and central nervous system all negative. The abdomen showed a three-inch median suprapubic scar and a six-inch upper right rectus scar. Moderate symmetrical distention, no visible peristalsis. Tenderness over the cæcum, the upper part of the long scar and over the splenic flexure. No mass or fluid. Solid viscera not palpable. Rectal and proctoscopical examinations negative.

Wassermann negative. Gastric contents showed no free hydrochloric acid; total acid, 22. Blood sugar, 102; uric acid, 4.8; non-protein nitrogen, 26; urea nitrogen, 15; icteric index, 4. Basal metabolic rate, + 11. Fecal examination showed a moderate excess of mucus, no pus, blood, parasites or ova. No pathogenical bacteria.

X-ray examination showed a vertical stomach, medium size, normal tone, medium low, normal peristalsis. The duodenal cap was large but showed no defects. The second portion of the duodenum made a wide swing to the right and appeared to be fixed in position. The third portion was moderately dilated and contained barium throughout the examination. The stomach and duodenum were empty in two hours. The colon was negative. Subsequently a Rehfuss tube was passed into the duodenum and this showed a sharp angulation at the junction of the duodenum and the jejunum.

After careful study of the physical and psychical factors operation was decided upon.

December 1, 1932. Duodeno-jejunostomy for partial duodenal obstruction. Freeing of adhesions of transverse colon to old incision scar and freeing of adhesions of great omentum to sigmoid colon. Liberation of high fixation of duodenum. The duodenum was explored along its course and was found to be decidedly dilated in its third portion. The duodenum was dilated up to the point where the superior mesenteric vessels passed over it. They undoubtedly played an important part in causing the obstruction.

*Results.*—Apparently improved though benefit uncertain.

Case XII.—Woman,* sixty-two years of age, was admitted to the New York Hospital, October 23, 1928, because of attacks of vomiting which had occurred for two and one-half years. First attack was in May, 1926. At that time she vomited green mucous material, no blood. Vomiting continued for one week. She had another attack of vomiting four months later lasting for several days and another attack the following month which lasted only one day.

There followed a period during which she was well. She then had three similar attacks in November and December, 1927, and one in June, 1928. Each attack of vomiting was preceded by belching of gas and epigastric distress. Following the attacks she lost her appetite and felt exhausted for several weeks. Dr. Walter Niles, who saw her first in June, 1928, reports that June 14, 1928, her urine contained a large amount of sugar, as well as a marked reaction for acetone. There was no diacetic acid; there was a faint trace of albumin, and numerous hyaline and granular casts. On June 15 her blood sugar was 186 milligrams per 100 cubic centimetres of blood; June 16 her blood chemistry was as follows:

| | | |
|---|---|---|
| Urea nitrogen ..... | 18.0 | milligrams per 100 cubic centimetres of blood |
| Non-protein nitrogen ... | 35.6 | milligrams per 100 cubic centimetres of blood |
| Uric acid ..... | 4.4 | milligrams per 100 cubic centimetres of blood |
| Sugar ..... | 136.95 | milligrams per 100 cubic centimetres of blood |
| Chlorides ..... | 468.75 | milligrams per 100 cubic centimetres of blood |
| Creatinin ..... | 1.879 | milligrams per 100 cubic centimetres of blood |

June 17 and succeeding days there was no glycosuria.

Her next attack began on September 27, 1928. There was again a large amount of sugar in the urine with considerable acetone and diacetic acid. The sugar persisted for

* Annals of Surgery, July, 1929.

four days, although the acid bodies disappeared in two days. Her blood sugar on September 28, 1928, was 198.

Fecal examinations made during the attacks showed large amounts of mucus and many undigested starch cells. There were no other evidences of pancreatic insufficiency. Lost twenty-five pounds during two and one-half years.

February 13, the abdomen was opened. Adhesions were freed between the gall-bladder and the duodenum. The colon was displaced downward and the duodenum mobilized. The duodenum and head of pancreas were then lifted mesially like a trap-door. The diverticulum was then identified closely opposed to the posterior aspect of the head of the pancreas. It was collapsed but measured about two inches in diameter. It was, of course, retroperitoneal. Four or five large thin-walled veins lay on its surface. These were ligated and divided. The sac then readily dissected free. Its wall was very thin; its neck two centimetres in diameter was situated at the lower part of the mesial

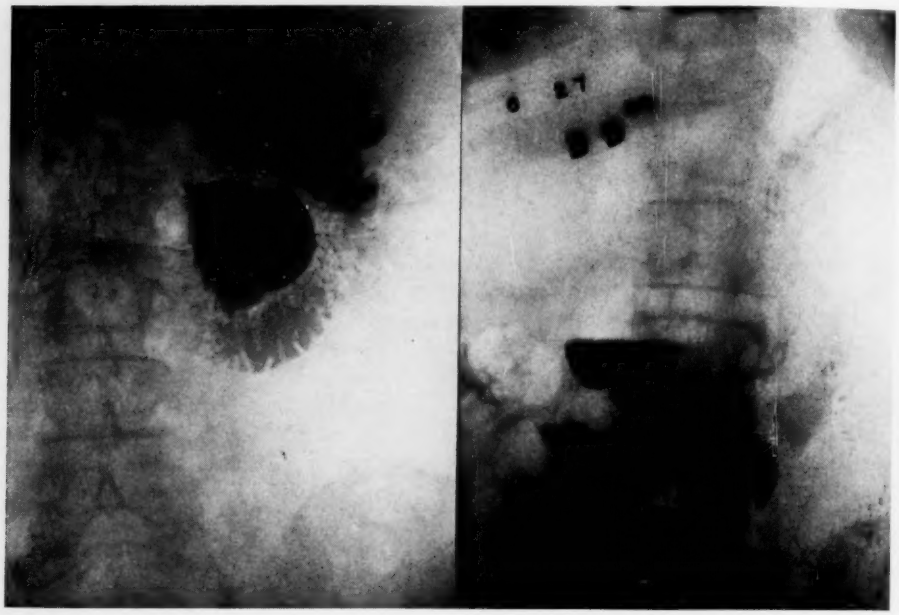

FIG. 12.—(Case XII.) Large diverticulum of duodenum.

FIG. 13.—Same case showing retention in diverticulum.

aspect of the descending duodenum. The diverticulum was excised a short distance from the duodenum. The orifice was repaired transversely with three rows of chromic gut. Extreme care and thoroughness were necessary on account of the inaccessibility and the retroperitoneal position. When the repair was completed it was felt that the lumen of the duodenum was so much encroached upon that obstruction might occur. Therefore a posterior gastrojejunostomy was done. The wound was closed without drainage.

Post-operative course entirely smooth. Patient discharged twenty-one days after operation. She has had no further complaints, eats everything, general health good. No sugar has been noted in the urine. February 3, 1929, blood sugar 125 milligrams per 100 cubic centimetres of blood.

This case is of interest, first, on account of the unusual situation of a large diverticulum (Figs. 12 and 13). It lay posterior to the head of the pancreas. Second, because of the peculiar symptoms, notably periodic attacks of vomiting with hyperglycæmia and glycosuria presumably due to pressure by the dilated diverticulum upon the pancreas or its duct. Third, these disturbances were cured by operation.

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DISCUSSION.—DR. WALTER L. NILES remarked that these cases are often overlooked because the röntgenologists generally do not center very much attention on the small intestine beyond the duodenal bulb. The condition requires a certain amount of looking for.

Doctor Pool spoke of fluoroscopy as being important. It is very much more helpful than are X-ray films. One may take a great many films and not get a single satisfactory delineation of the terminal duodenum. The fluoroscopical examination is essential to the recognition of these cases.

About half of them have severe attacks of pain that are sometimes mistaken for more serious conditions, like cholecystitis. One young woman regarding whom Doctor Pool just reported was taken to a hospital with a suspicion of acute intestinal obstruction.

With congenital high fixation of the duodenum, the symptoms usually can be traced back to infancy and childhood. In these cases of chronic duodenal stasis the symptoms usually do not begin until later in life and sometimes not until quite late. He recently saw a woman of fifty-eight who had suffered from symptoms only during one year. She had a well-marked dilation of the duodenum with stasis. Probably the condition had been there, at least to a certain degree, for a good many years, but owing to exceptionally good health and muscular tone she had suffered no symptoms. Recently she had been subjected to unusual nervous strains, she had developed symptoms. It is very possible that with improvement in her nervous condition and her general physical condition she may again regain her compensation. At fifty-eight she is probably less likely to do so than if she were younger.

One other point regarding symptoms, and that is that they usually come on very quickly after meals, not infrequently while the patients are still eating. Sometimes they say they feel as if there is a lot of gas in the stomach and they wish they could belch it but they are unable to. A very pronounced and striking feature of all of these chronic cases is the psychic state. The psychoneurosis is profound in every one, and that, of course, complicates the picture a great deal and also makes decisions regarding the proper treatment more difficult. The whole picture is often attributed to a neurosis. They may have had several operations already and one naturally hesitates to advise another fearing the result of added psychic trauma. However, it should be done with the understanding that it is only the first step in their reconstruction and that subsequently they may, and probably will, demand psychic reëducation.

Doctor Pool spoke of a temporary functional disturbance of the duodenum. Doctor Niles was sure that it occurs. He had seen it demonstrated by the fluoroscope in quite a number of patients who had recently suffered illness or prolonged strain. A great many of those clear up, that is, they regain their compensation with the restoration of their nerve tone and general nutrition.

These patients generally present a picture of asthenia or hyposthenia. One thinks of them as enteroptotic types. We have come to feel more and more that the classification depends on the state of nutrition. For instance, in some of those operated on, when they have gained a good deal of weight they no longer present a picture of hyposthenia.

It is true that a great majority of these patients respond fairly well to medical treatment, which naturally consists in giving them a bland diet, small meals, often repeated, perhaps a period of rest in bed, certainly rest after meals, possibly hot applications, and sedative measures to relieve the irritability of the duodenum. There does remain, nevertheless, a group which, in his experience, has been about one-third, who are not relieved and require surgery.

His personal experience was limited to six cases in which the results had been good invariably. He felt, therefore, that in properly selected cases operation for relief of this condition was one of the most satisfactory ones in surgery. It is obvious that these cases require very careful study and they need the combined interest of the surgeon, the internist and an intelligent röntgenologist.

Dr. George W. Crile (Cleveland, Ohio) said that they now have a series of 209 cases of duodenal stasis to report from the Cleveland Clinic. In all of these cases the diagnosis was made by the X-ray department. Out of that number, twenty-one have been subjected to exactly the same operation that Doctor Pool has so well described. Of this group, improvement was noted in ten cases, and in four cases there was no improvement. Seven cases could not be traced. This brief statement he made merely as a basis for discussion.

He had only two points to add to the experience reported by Doctor Pool and Doctor Niles. First, in their series, the patients who were not improved practically all belonged to the group who have what is called by the internist a constitutional inferiority complex. In these cases, the patients never have felt well. Such patients do not improve.

The second point he wished to make is that the fluoroscopical examination is the important thing. The reason why they had had such a large series of cases of duodenal stasis reported by the X-ray department is that a long time ago one of his first patients who had stasis of the duodenum and migraine showed such striking results. From that time on they subjected their cases of migraine to fluoroscopical examination to see whether or not it was associated with obstruction at the duodenum. It is extraordinarily striking, when one gets the right diagnosis, to see how promptly migraine is relieved by the simple operation described by Doctor Pool.

In their cases, one out of ten patients was subjected to operation. There were quite a few cases in which they got no valid improvement, most of them being among the cases of constitutional inferiority.

Finally he emphasized the point that it is well worth while as a routine measure in cases of migraine to make a fluoroscopical examination of the duodenum.

Dr. Allen O. Whipple (New York City) called attention to one phase of this subject which had not been sufficiently noted in the cases having duodenal stasis. In some thirty-two to thirty-four cases of duodenal stasis that have been studied largely as a result of Doctor Golden's interest in the fluoroscopy of the duodenum, they had found nine cases of this anomaly: the normal curve of the duodenum has shown a reversal in these nine cases; instead of the normal curve to the left, a curve to the right is given.

Two of these cases have been operated upon and have been observed carefully. The duodenum has been noted to pass behind the pylorus and the pancreas, emerging at a variable position as the duodenal jejunal junction. In these nine anomalies a marked stasis had been noted in five; two of these have been operated upon and both patients have given excellent results. In the two cases in which operation had to be done a duodeno-jejunostomy was done. A very definite angulation was found in the area posterior to the passage of the terminal duodenum behind the pancreas and the stomach. Unless these cases are carefully studied by fluoroscopy they will not all show in the X-ray by any means. In two of the cases, in fact, the films that were taken subsequently did not show on the film and it was only by subsequent studies that the outline of this reversed curve was noted both in fluoroscopy and in the film.

Dr. Leonard Freeman (Denver, Colo.) called attention to a congenital anomaly of the duodenum which has been the cause of the majority of instances of duodenal obstruction which he had seen, and which he had described in an article written in 1920 (Surg., Gynec., and Obst., p. 454, May, 1920). The anomaly just spoken of by the previous speaker is, of course, of importance; but the one to which he now referred was different. It is a hangover from fetal life. He had encountered it a number of times.

The duodenum normally passes behind the mesentery of the transverse colon to the duodeno-jejunal angle, where it is hung up by the jejunal fold, so-called. In this particular anomaly, which will be found quite frequently if one looks for it, instead of passing immediately to the left the duodenum drops directly down toward the pelvis underneath the colon, forming a long pendulous loop with a mesentery of its own. It is thus loose and dangles within the abdominal cavity, but always it is fastened up to the normal position by the jejunal fold, at the duodeno-jejunal angle, near the root of the mesentery of the transverse colon. Being hung up in this way, like a soft rubber tube over a nail, it becomes kinked and, in addition, twisted to a certain extent upon its axis, thus adding to the obstruction.

There are two ways of remedying this obstruction surgically. One is by duodeno-jejunostomy, so well emphasized by Doctor Pool. The other is to divide the adhesions constituting the jejunal fold, at the duodeno-jejunal junction, which is usually not difficult unless the patient is too fat. This often leaves a large, raw surface which can readily be covered with peritoneum. Such an operation is devoid of danger if one is at all careful of the surrounding structures. It answers the purpose just as well as an entero-anastomosis and may be preferable because it not only relieves the obstruction by straightening out the duodeno-jejunal angle, but it does this without opening the bowel or leaving any excluded portions to give trouble later on.

Dr. Eugene H. Pool (New York City) said of course these cases have to be very carefully selected. Cases of constitutional deficiencies should not be operated upon for this or anything else except in emergencies.

Duodeno-jejunostomy for an obstruction higher than the transverse portion of duodenum is, of course, contra-indicated.

The anastomosis will not be effective if the obstruction is in the second portion of the duodenum. Duval has devised an operation which he calls a gastro-pyloro-duodeno-jejunostomy, to drain the upper part of the duodenum, pylorus and stomach. It has been done by Duval and his associates about a hundred times. It seems a bizarre procedure but is worth bearing in mind if one encounters a sharp obstruction in the lower part of the descending portion of the duodenum which, very occasionally, occurs as a result of a low duodenal ulcer. He had seen one such case.

# THE TRAGEDY OF GASTRIC CARCINOMA

## A STUDY OF 200 SURGICAL CASES

By Urban Maes, M.D.,
with Frederick Fitzherbert Boyce, M.D.,
and Elizabeth M. McFetridge, M.A.
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FROM THE DEPARTMENT OF SURGERY OF THE LOUISIANA STATE UNIVERSITY MEDICAL CENTER

In the ten-year period extending from 1922 through 1931, 758 patients were treated in the New Orleans Charity Hospital for carcinoma of the stomach, with a hospital mortality of 245, or 32.3 per cent. Nearly three-quarters of these patients, 533, or 70.3 per cent., were not treated surgically, chiefly because they were far beyond the reach of surgery, and 148 of them died in the hospital, a mortality of 27.7 per cent. Of the 275 patients who were operated on, ninety-seven died in the hospital, a mortality of 43 per cent. That 15 per cent. difference in the death rates could be used by those persons, professional and lay alike, who are not surgically minded, as an argument against the performance of surgery for this disease, but it would not be a fair argument. I do not know how many of the 128 men and women who left the hospital alive after operation are still alive, but I suspect it is only a negligible number, for only a negligible number had the sort of surgery from which any hope of cure could ever be expected. But I do know that if the diagnosis of carcinoma of the stomach were correct, as the hospital mortality of 27.7 per cent. proved it to be in 148 cases, at least, then none of the 385 men and women who left the hospital without surgery can possibly be alive now. They did not die within the walls of this century-old institution that has sheltered and succored so many in their last hours, but without exception as they went forth from its doors, in no better condition than when they entered them, they carried the candle of death in their hands and on their faces the seal of death was set. Surgery may achieve little in this disease, but without surgery there can be no salvation.

Of gastric carcinoma there is little new to write, but that does not mean that of gastric carcinoma much should not be written. Only by ceaseless study, only by unremitting effort, can we hope to increase our salvage—it is literally a saving from shipwreck—in this most tragic of all diseases. We make no apology, therefore, for presenting to this Society an analysis of carcinoma of the stomach which is based on the last 200 surgical cases done at Charity Hospital. We have studied these cases clinically rather than statistically, in an endeavor to find out, so far as we could from the records, why ninety of the patients died within the hospital, and why, of the 110 who went out alive, only sixteen could possibly hope to be permanently cured.

From every standpoint this is a perfectly fair analysis. Racially, the

incidence and the mortality are strikingly alike: 101 white patients with forty-six deaths, ninety-nine Negro patients with forty-four deaths. While the percentage of males, 172, or 86 per cent., is rather higher than is usually reported, the predominance of the disease in men is unquestioned. Although more than three-quarters of the operations were done by ten surgeons, the 200 cases were distributed among thirty-one surgeons, and that, again, is as it should be in such a study, for it is as it would be in practice. The argument is perfectly sound that gastric surgery should be done only by surgeons trained and experienced in that particular work, but actually we all know that gastric surgery, and every other variety of surgery, for that matter, is most often done by surgeons of average experience or small experience or no experience: so long as patients are willing to be operated on by surgeons of all grades of competence and incompetence, just so long must the results of all surgeons be figured in the statistics. Finally, this is carcinoma of the stomach as it is really seen. This is carcinoma of the stomach as it most often reveals itself to the surgeon, not in a selected group of patients with a relatively high percentage of operability and a correspondingly brilliant percentage of cures, but in the patients who seek us and our aid just before the curtain falls. Because it is the material of a general hospital, it is material that represents the general population, and so it is the true tragedy of cancer.

One of the first points that impressed us as we surveyed these cases was the age of the patients. The age limits were twenty-one to seventy-nine, with the highest incidence, 38.5 per cent., in the sixth decade, and the next highest, 25.5 per cent., in the fifth. That is what we have been taught and what we would expect. But it is highly significant that three patients were under thirty-years, the youngest being twenty-one, and that fourteen others were under forty, which means that 8.5 per cent. were well below even the lowest limit usually set as the boundary of the cancer age. Alvarez[1] has made the statement that one out of every nine persons with carcinoma of the stomach is under forty-five, but in this series approximately one out of every nine was under forty. Is not the overlooking of just such facts as these one of the causes of the terrific mortality we are attempting to analyze? It is quite true that the younger the patient with gastric symptoms, the less likely is his disease to be malignant, but it is also true that in medicine, no less than in life, the proportion of probable error is always far higher than is realized, and the possibility of cancer, therefore, must ever be borne in mind, regardless of age limits, regardless of the law of averages. Particularly should the possibility of cancer be borne in mind before the facile diagnosis of benign disease is made and the patient is treated by non-surgical measures.

We next investigated these patients from the standpoint of the duration of their symptoms, and we found that seventeen had been aware of their illness for less than a month and 108 for less than six months, the mortality for the whole group being 47.5 per cent. To a certain extent, we presume, the stories can be discounted. Perhaps they were told inaccurately, perhaps

they were recorded carelessly, perhaps the symptoms had actually lasted much longer but were realized only for that length of time because sensibility was really decreased and the threshold of pain was really increased. The realization of the symptoms, however, is the patient's reason for medical consultation, and the fact stands that in one half of the patients in the series that realization was of very short duration, although the inherent gravity of the disease, the inroads it had already made, are indubitably proved by the death rate. But at the other extreme, twenty-one of the patients, nearly 10 per cent., told a story of symptoms which had lasted from five to thirty years. Some of these people had sought no medical advice until they sought hospital admission, and the responsibility for that delay does not lie at the door of the medical profession, but many of them had been treated medically, on vague diagnoses or none at all, for varying periods of time before their admission, and in those cases the responsibility for the delay is clear and plain. Moreover, aside from that consideration, how is one to reconcile the facts of a disease in which the duration of symptoms may be anywhere from two weeks to thirty years?

A statistical analysis of symptoms is in our opinion never satisfactory, and therefore we have not attempted it, but we arrive at the definite impression of certain symptom groups as we review these histories. We note a group in which the symptoms are ushered in abruptly, frequently by a dietary indiscretion, from which, perhaps, there is never full digestive recovery. We note a group in which the symptoms date from a previous, apparently unrelated illness, from which recovery is slow and the weakness and malaise of which tend to linger. One such patient, for instance, had had a full-term delivery a month before she was hospitalized for the gastric carcinoma from which she died; her symptoms had been masked by the events of her gestation and did not manifest themselves independently until after her delivery.

We note a group in which the first symptom, if we can trust the story, is hæmatemesis, and another group in which vomiting of the coffee-grounds type is the outstanding feature. We note a group, a rather large group, in which the symptoms are vague and undetermined. These individuals have ceased to enjoy life. They suffer from malaise, they lack strength, they have lost weight, they do not care for their food, they prefer not to eat it, they are constipated when they have never been constipated before, their whole mental and physical outlook has been changed. Digestive symptoms are a late development; sometimes they manifest themselves only as the end draws near. A surprising number of patients in this group entered the hospital actually unaware that their illness had anything to do with the gastro-intestinal tract.

Then there is the group in which, on a basis of previously sound and previously robust health, digestive symptoms are superimposed. At first there is epigastric discomfort which is unrelated to food, then there is definite pain which is increased by food. At first there is merely nausea, or the

regurgitation of mucus, then there is vomiting, and much later there is the vomiting of food which has been eaten hours or even days before. In some of the patients in this group the diagnosis of gall-bladder disease was certainly warranted, at least in the beginning, for their first indigestion was definitely qualitative. If they ate certain kinds of food they knew they would suffer for it, and so, very sensibly, they regulated their diet by the trial and error method, until eventually they found out what they could eat safely, even though sometimes it amounted to little more than liquids.

All of these patients were proved by operation, and many of them by autopsy also, to be suffering from carcinoma of the stomach, and yet in the 200 cases there are almost a dozen different clinical syndromes. Their symptoms, considered individually, could mean anything or nothing, but the single symptom is never comparable in importance to the symptom group, or to the person in whom it arises. There is not a case in the series in which, in the light of what happened later, the diagnosis could not have been made if the patient had consulted the physician promptly and if the physician had considered his patient as an individual suffering from an individual illness instead of endeavoring to thrust him and his symptoms into a ready-made diagnostic groove. If we emerged from this study with no other idea, we did gather from it that the only safe mode of medical practice is to consider every patient as an exception to the rule, on the ground, as Gordon[8] puts it, that while averages are quite true of the population at large, they are entirely untrue of the patient as an individual. Granted that in some cases early symptoms seem to be lacking, in the majority of cases the trail is there, the physician simply fails to find it, or having found it, fails to follow it, because it is not a broad and straight highway. We believe, therefore, that from the standpoint of diagnosis the best aid is a carefully taken history, a history which is secured only by patient and persistent questioning, and which takes note, as Moynihan[14] says, of the earliest departure from health of which the individual has knowledge rather than of the symptom complex which now occupies his attention.

One group of patients we have purposely reserved for discussion until this point, for their introduction is always the signal for the bursting of a storm. We read these histories with particular care. We charged ourselves sternly against bias and preconceptions. In our endeavor not to be prejudiced we literally leaned over backward, and we discarded many cases which other observers, we feel sure, would have included. But with all these precautions and all these exceptions we still found that 25 per cent. of these patients gave a perfectly typical, perfectly definite story of gastric ulcer. That they all had ulcers is, of course, unthinkable, and we do not claim it, but that they told ulcer histories we do contend, and that some twenty-nine of the fifty, at least, were treated for ulcers their records clearly prove.

We set up specific criteria for our classification. We required symptoms of more or less long-standing; in twenty-one cases they had lasted two years or more, and in fifteen cases they had lasted more than five, which is well

beyond the period untreated cancer patients could be expected to live. We required that the epigastric discomfort definitely be related to food, and that it be relieved by the taking of food and alkalis and by the institution and maintenance of a bland diet. And we required also intervals of remission, for in such remissions, in our opinion, lies the chief difference between the ulcer history that is provoked by an ulcer and the ulcer history that betokens cancer.

We admit that we concerned ourselves purely with clinical data, for we share Moynihan's[14] opinion of the value of that sort of evidence when it is rightly acquired and honestly assessed. We believe, also, that the clinical aspect is far more important than the pathological, and it therefore does not change our opinion to find the surgeons in the operating room and the pathologists in the laboratory and in the autopsy room reporting that only thirteen cases of the 200 manifest the association of ulcer and cancer. We agree with Moynihan again, that at the operating table and in the post-mortem room the evidence of the ulcer is frequently obliterated, and that "not all the palimpsests can be deciphered."

The pathologists question the superimposition of carcinoma upon ulcer, or they deny the transition from ulcer to carcinoma, whichever way you may choose to regard it, and academically their position is probably unassailable, though personally we cannot comprehend why chronic irritation within the stomach should not have precisely the same effect that chronic irritation anywhere else would have. That, however, is not the point at issue, any more than the point at issue is the one over which controversy so often and so mistakenly rages, the percentage of cases in which carcinoma is associated with ulcer or is superimposed upon it or develops from it. The point at issue, and it is a purely clinical point, is that some patients with a definite ulcer history, with a radiological diagnosis of ulcer, with laboratory findings typical of ulcer, with all the clinical and scientific evidence in favor of ulcer, prove the utter unreliability and worthlessness of that evidence by dying of cancer. When or where or how the malignancy originated may interest the pathologist, but it is not of the smallest interest to the clinician who made the mistake and to the patient who paid with his life for the error. Fourteen of the twenty-nine patients in this group who were treated medically for a supposed ulcer died in the hospital, and in not a single one of the remaining cases could resection be done, which means that the other fifteen patients were just as clearly doomed to death. This series, and every similar reported series, makes one fact very clear: that the differentiation between gastric ulcer and gastric cancer is impossible by any known means short of surgical exploration—and it is not always easy or always possible then—and that one of the chief factors in the mortality of carcinoma of the stomach is the medical treatment of supposed peptic ulcer, particularly when, as so often happens, the medical treatment is temporarily successful.

Almost the only thing common to the majority of these patients was a marked loss of weight, a loss that is always more pronounced in gastric

carcinoma than in any other disease which gives rise to gastric symptoms. Only twenty-six patients were described as well-nourished, though an appearance of health is, of course, not incompatible with a wide dissemination of the disease. One hundred fifty-nine patients, or 79.5 per cent., had suffered a loss of weight ranging from ten or fifteen pounds in many patients, to fifty pounds in two patients, both of whom died, and seventy-five pounds in one who, surprisingly enough, left the hospital alive. The terms emaciation and dehydration appear on these charts with monotonous frequency, and it is only too easy to picture from them the ashen-faced, sunken-eyed, pinch-nosed old men who represent the disease as it is usually seen in hospitals and as it should never be exhibited to students and to young physicians, except as a terrible warning.

Eight of the patients were jaundiced, of whom three died, for jaundice is a late sign and an ominous one. In eighty-five patients, thirty-eight of whom died, a definite mass could be made out. In only five cases, three of them fatalities, was Virchow's node palpable, probably, we surmise, because it was not looked for oftener. In not a single case was metastasis to the rectal shelf noted pre-operatively, and it is mentioned in only a few of the operative records. This metastasis, which in our opinion is often the deciding factor in the debate over operability, is for some reason mentioned only rarely in the literature, and it is not surprising that both histories and operative records should have ignored it also.

It required no particular degree of astuteness to make the diagnosis in most of these cases; as happens only too often in malignant disease, it was so clear-cut that it carried with it the inevitable corollary of the improbability of cure. But the usual means of confirmation were naturally employed. The X-ray, the most certain of all diagnostic aids, was employed in 165 cases, being omitted only when operation had to be done without delay for hæmorrhage and acute obstruction, or when the diagnosis was so evident and the indication for some sort of palliative procedure was so plain that the patient was not put to the added discomfort and inconvenience of a barium meal. In six cases it was negative, in seven it was incorrect—it is curious that only once was the diagnosis of gastric ulcer suggested—and in 92 per cent. it was positive.

We pause at this point to emphasize the limitations and the actual dangers of the X-ray when it is used as anything more than a confirmation of clinical suspicion. Naturally, the more advanced is the disease, the higher is the percentage of correct diagnoses and the less necessary is the aid of the radiologist—we write, as did Alvarez,[2] not in malice but in humility. But it does not follow that the radiologist is at fault because he does not detect the early case. The tumor may be so located that it cannot be seen. It may be so small that it is not demonstrable. There may be no infiltration of the muscular coat, and the evidence of the arrested peristaltic wave, which is generally regarded as the earliest radiological sign, may be entirely lacking in repeated examinations in all positions. The fact that X-ray study is negative is no

proof against the existence of a neoplasm; it was negative, as we have already pointed out, in six instances in this series.

The chief objection to the X-ray as a method of diagnosis is the clinician's increasing habit of letting it do his thinking for him, and of guiding his procedure by what it does and does not reveal. We question whether a decision as to operability should ever be made on the basis of the X-ray findings alone. They are, as Moore[13] points out, of great value in determining the location of the tumor, of doubtful value in demonstrating fixation, and practically never of value in revealing metastases, upon the existence of which depends the decision as to whether and how operation should be done. As a matter of fact, the X-ray should always be used with safeguards and with reservations. Its eye, as Golob[7] well puts it, is never analytical, and the tendency of physicians generally to let it halt further investigation when the report is negative makes one wonder, on occasions, whether it might not be well to invoke it as a last resort rather than as a first aid.

Upon other laboratory investigations we set varying values. The presence of occult blood, either in the gastric contents or in the stools, is a definite indication of ulceration, but is of no value in demonstrating where the ulceration is located or of what variety it is. We agree with those observers who claim that gastric analysis is of small help in the early case, in which it is most needed, though it is usually perfectly characteristic in the late case, in which the diagnosis needs only confirmation, if that. It was done in 104 cases in this series, ninety-seven of which exhibited a hypoacidity with a hypochlorhydria or an achlorhydria, but those findings are typical of many other diseases, while a certain school holds, perhaps, with reason that achylia is an antecedent of gastric carcinoma rather than a consequence.

The anæmia of carcinoma of the stomach is an established fact and it is granted that it may be of so profound a degree as to mimic pernicious anæmia; Moynihan[14] suggests that in doubtful cases it be differentiated from it by the therapeutic test of the Murphy-Minot diet, to which primary anæmia responds brilliantly but secondary anæmia poorly if at all. In this series, in some 75 per cent. of the patients, the anæmia was more or less marked, sometimes running as low as 1,200,000 red cells and 30 per cent. hæmoglobin, even without the factor of hæmorrhage to explain it, but we found, as did other observers, no constant relation between the degree of anæmia and the stage of operability.

Leucocytosis, never to a very marked degree, we found in some 15 per cent. of the cases, not a surprising finding in view of the infection frequently associated with advanced carcinoma. It is rather surprising, however, to find some 20 per cent. of the patients whose blood was studied suffering from a leucopenia, sometimes as low as 2,500. Are we to interpret this fall in the white cells as evidence of the degree to which this disease reduces the resistance of the host? The percentage of renal disease, which naturally has nothing to do with the malignant process, as shown by a reduced phenolsul-

phonpthalein output and an increased retention of non-protein nitrogen, was about what would be expected in a group of patients within these age limits.

Looking at these histories in retrospect, we gather from them that there is no symptom that is always present, and likewise none that may not sometimes be absent. We gather from them that diagnostic difficulties increase in exact proportion to the promptness with which patients seek medical aid, for the early symptoms, while they are important in the aggregate and eventually, are insignificant and misleading individuallv and presently. We gather that digestive distress, which would seem logically to be the cardinal symptom of a disease located in the stomach, may be entirely absent, and if present, may be no more characteristic of carcinoma than of any other disease with gastric manifestations.

Since there is clearly no specific laboratory test, chemical, serological or microscopical, upon which reliance can be placed, and since the very excellence of modern laboratory methods introduces the danger of overlooking even more valuable subjective and objective evidence, we are driven back to purely clinical considerations. We gather from these histories that there is just one plan of diagnosis that is even reasonably safe: to regard as cancer any indigestion, with or without symptoms, which appears after middle life, acutely or insidiously, in a previously well person; to regard as cancer any acute digestive disturbances within this period which are superimposed upon chronic digestive disturbances and which do not respond promptly and permanently to routine measures which have heretofore been successful; to regard as cancer, or as highly suspicious of it, such vague general symptoms as fatigue, malaise, mental indifference, insomnia and loss of weight, even though associated gastric disturbances are entirely lacking; to continue to regard as cancer any one of these clinical syndromes until it is proved beyond shadow of doubt not to be cancer; to make the diagnosis with the aid of auxiliary methods, but never on the basis of them; and, finally and most important, to resort without delay to exploratory laparotomy if the diagnosis cannot be made positively without it.

Even when these rules are sedulously obeyed, there will still be errors of diagnosis, but perhaps there will be fewer tragedies due to delay. Why patients do not consult physicians with more promptness is an unsolved mystery. The group which fears cancer too much or surgery too much to investigate symptoms that cry aloud for investigation is beyond comprehension but it must be reckoned with. Another group consists of the patients who, having suffered from digestive distress over a long period of time, do not recognize the significant change in the character of their symptoms. There is the group we have already spoken of, who are either unusually stoical or have an unusually high threshold of pain, and so who are honestly unaware of their symptoms until their disease is far advanced. Finally, as McVicar and Daly point out, the typical carcinoma age is the age in which certain discomforts due to involuntary degeneration, focal infection and similar causes are to be expected, and are ignored by the breadwinner of the

family who must maintain his place in the competitive struggle, a reason that is even more tragically true in this day than it was when the lines were first written.

But the patient is not always to blame. In this particular series there were very few cases in which, at least when hospital admission was sought, the diagnosis was not evident with ghastly clarity, and the delay until operation was never very great. It was sometimes longer than it should have been because the mechanism of hospital consultations sometimes moves slowly, but there were few instances in which it was not relatively prompt. But before admission, as we have already pointed out, at least some physicians delayed and temporized, and their number, had the records been written more carefully, would undoubtedly be greatly increased, for in every reported series the same errors have been made. In the series reported by Saltzstein and Sandweiss,[17] for instance, some patients had had medical treatment for an average of eight and one-half months. Oughterson[15] mentions one man who had been seen by twelve physicians over a period of two years. Surely if the medical man, or the surgeon, for that matter, cannot put an exact name to a disease, he can at least carry always in mind the thought of malignancy, and he can refrain from any advice and any treatment that does not involve surgical exploration. Cole[5] mentions, with a very high degree of scorn, the routine wording of the X-ray reports of a decade or two ago: "This patient has a filling defect, the exact nature of which can be determined only by surgical exploration," but his scorn is out of place; it would profit a great many patients today if their X-ray reports carried the same explicit statement and the same implied warning, and if medical men generally paid heed to the admonition.

Of the 758 patients admitted to the hospital during the ten-year period we took as the starting point for our investigation, a few refused surgery, but the majority of the 533 medical cases were medical because they were obviously beyond the reach of surgery; 27.7 per cent. of them proved that promptly and conclusively by their deaths. During that period, in other words, less than 30 per cent. of the patients with carcinoma of the stomach could be considered as candidates for surgery of any sort. Now, taking as typical the 200 cases we studied in detail, it is apparent that the majority of those who were operated on were considered as surgical risks of any sort only by the most generous application of surgical indications. The mortality of ninety, or 45 per cent., proves that very clearly, as does the division of the cases: gastrectomy, the only procedure which offers the faintest possibility of cure, could be done in only thirty-five cases, 17.5 per cent. of the series, while in fifty-six cases, or 28 per cent., the abdomen was closed as soon as it was opened, for any sort of surgery was hopeless.

To consider the figures in detail, 17.5 per cent. of the patients were submitted to gastrectomy, with an immediate mortality of 51.4 per cent., as compared with 43.75 per cent. in the series reported by St. John,[19] 52.6 per cent. in the series reported by Oughterson,[15] and 40.3 per cent. and 64 per

cent. in two series collected by Saltzstein and Sandweiss.[16] On Balfour's[3] report of a 10 per cent. mortality in 200 cases we shall comment later. Eighty-three patients, or 41.5 per cent., were submitted to gastroenterostomy, and the mortality was 43.6 per cent., as compared with 26.6 per cent. (exploration is probably included) in St. John's series, 28.3 per cent. in Oughterson's series, and 66 per cent. in Saltzstein and Sandweiss'[17] series. Fifty-six patients were submitted to exploration, and the mortality was 30.4 per cent., as compared with 21.7 per cent. in Oughterson's series, and 58.6 per cent. in Saltzstein and Sandweiss' series. Twenty-one patients, or 10.5 per cent., were submitted to gastrostomy or jejunostomy, and the mortality of nearly 81 per cent. needs neither comparison nor explanation, for all of the operations were done upon patients who were either frankly moribund or were in the last stages of their disease, but for whom some attempt at relief seemed imperative.

This is an appalling record from every standpoint, but our own figures and the figures of other series reported on the same basis bear a striking similarity. We would emphasize again that the reports from such institutions as The Mayo Clinic and by such surgeons as Balfour are in no way representative of the general run of material or of the general results of surgery. They represent an ideal to be striven for, but we stultify ourselves if we say that it is likely to be soon attained. A search of the literature shows that statistics compiled from and based on the general population and on the population of general hospitals are invariably tragic figures. Resection, speaking categorically, is seldom possible in more than 8 per cent. of all cases, and the prospect of cure is immediately cut in half by an operative mortality of at least 50 per cent. That means that ninety-six out of every 100 patients are today doomed to death from the outset of their disease. Furthermore, while surgical exploration for purposes of inquiry, as Moynihan very correctly says, has scarcely any mortality in this aseptic era, surgical exploration for purposes of inquiry at the first exhibition of symptoms and surgical exploration near the end of an illness, in the vain hope that something can be done for obviously hopeless disease, are two very different considerations, and the mortality of the latter procedure is inevitably high.

Let us grant freely that technical errors and bad judgment and, to be quite frank, a certain amount of inexpert surgery, account for part of this fearful mortality. But it does not account for it all, and the question immediately arises as to what are the criteria for surgery under these circumstances, and what is the surgical ethic. Clinically, the decision for or against operation is made on the general condition of the patient, the estimated extent of his local disease, and the probable existence of metastases. Had those considerations been strictly weighed in this series, many of the patients would certainly not have been operated on; they were poor surgical risks, their disease was of long standing, and the presence of metastases could have been assumed. But the physician who advises against surgery and the surgeon who withholds surgery take upon themselves a very grave responsibility.

There is always the chance that the clinical evidence is wrong, always the chance, even in the most hopeless-seeming cases, that something can be done for comfort, even if nothing can be done for cure.

What should be done when the abdomen is opened is another matter. Too often nothing is possible, though, if the patient survives the operation, a surprising and inexplicable degree of temporary clinical improvement is often noted. Gastroenterostomy is rarely indicated unless actual obstruction exists or unless the location of the tumor makes it clear that it is likely shortly to occur. W. J. Mayo speaks of "the hopeless gastroenterostomy that enables the patient to live longer and suffer more," but that is not altogether fair; every surgeon can recall wisely selected patients whose remaining days were made more comfortable by this procedure. Gastrostomy and jejunostomy are frankly operations of despair; the results are always bad and the mortality is always high; they are done upon frankly dying patients, but at that, they have their field. Gastrectomy is the ideal operation when it is possible, for it is the one form of surgery from which any permanent results can be expected, but it is only rarely possible. It is frequently a wise procedure, however, even when the circumstances are not favorable, for the mortality is often no higher than the mortality of gastroenterostomy, indeed is frequently lower, and if it does succeed it gives a degree of comfort and well-being, temporary though it be, that more than compensates for the immediate risk.

Ninety of these 200 patients died, and in at least half of those ninety cases the fatality was frankly attributable to the operation, for it was precipitated by shock, by hæmorrhage, by peritonitis, or by other definitely surgical complications. We do not doubt, as we have said, that in some cases, at least, the surgeon was at fault, though we would emphasize again that very few of these patients were good surgical risks, and that the majority of them were very poor risks; it took courage to operate on them at all. But all of that is beside the point. As far as we are concerned, the mortality, terrifying though it be, is justified, for the patients who died were clearly doomed, with or without operation.

The surgeon has every reason to reproach himself if, for the sake of his own fair record, he withholds from doomed men and women their frail chance of life. He need not reproach himself for his surgical mortality when he gives them that chance. Without surgery, the death rate in carcinoma of the stomach is 100 per cent., and it cannot be too often emphasized that every patient saved from death by it is a patient who otherwise would have died. There is an old Arabian proverb to the effect that he is no physician who has not slain many patients, and the surgeon who operates for carcinoma of the stomach must remember that often, just as he must remember, too, what Royster says, that where there is no surgical vision the patients perish. The duration of life after operation is only one aspect of the question; another consideration, and quite as important a consideration, is the freedom from pain and suffering which surgery brings to pass and which cannot be

reckoned in statistical tables. For the patient with carcinoma of the stomach is, as the inscription over the cancer wing of the Middlesex Hospital reads, truly the responsibility of the physician "until he is relieved by Art or released by Death," and the surgeon, as Cheever[4] says, is truly the agent of relief, whichever way relief may come.

SUMMARY.—(1) The appalling mortality of carcinoma of the stomach warrants a further consideration of the disease.

(2) A clinical analysis is made of 200 consecutive surgical cases from the records of Charity Hospital in New Orleans.

(3) From the standpoint of diagnosis these cases are studied in regard to age, duration of symptoms, symptom groups and laboratory findings.

(4) The relationship of gastric cancer to gastric ulcer is considered in its clinical aspects.

(5) The criteria of safe diagnosis are set down.

(6) The various operative procedures employed are considered from the standpoint of mortality.

(7) The conclusion is arrived at that surgery is justified in carcinoma of the stomach, even in apparently hopeless cases, because of the possibilities of temporary relief if not of permanent cure.

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DISCUSSION.—DR. FRANK H. LAHEY (Boston, Massachusetts) said it appeared to be very difficult to arrive at definite conclusions regarding the question of malignancy in gastric ulcer. They have had in their Clinic 172 gastric ulcer patients. Of these, ninety-two have been accurately followed after non-operative treatment. The true test of pathological diagnoses is what happens to the patients in years to come. Of all who were diagnosed ulcer not operated upon and carefully followed up, only one developed carcinoma. The question of what percentage will develop carcinoma and what percentage will not depends to a great extent upon how carefully they are studied and how accurately they are segregated into ulcer and cancer in these diagnostic examinations.

One can say that the danger of malignant degeneration in lesions which simulate or are ulcers is as follows: 100 per cent., in their experience, of the lesions of the greater curvature have proven malignant. The next lesions which tend most to become malignant are the pre-pyloric lesions, and the closer they are to the pylorus on the gastric side the more often they are malignant. Next in danger of malignancy are the posterior wall eroding ulcers, and the least liable to be malignant are the alcove lesions on the lesser curvature.

His experience has been that exploration for the demonstration of malignancy in gastric ulcers was disappointing. When he found on visualization of the lesion that he had metastasis in the liver with white pearly plaques in the peritoneum, and firm glands in the mesentery, those lesions can usually be diagnosed as malignant before operation.

On the other hand, when one exposes the hard, calloused chronic gastric ulcers with none of these distinguishing features, then one just cannot say whether it is malignant or not and the operation no longer becomes an exploration. One hesitates to close this patient with a suspected malignancy, and resection is done.

He has therefore sought additional help in the demonstration of possible malignancy in the border-line gastric ulcers. He thinks the plan which most of the gastroenterologists now practice is a very valuable one. It is particularly applicable to ulcers on the lesser curvature and the pre-pyloric ulcers. These patients are put to bed on a careful medical régime. They are fluoroscoped every two or three days. As long as the lesions tend to diminish in size, occult blood disappears from the stool and the symptoms are showing improvement, these patients are not operated upon.

If, however, he wishes to safely segregate the carcinomas from the non-carcinomas, the final criterion is that the defect, under this plan of management, must ultimately disappear and so must all the symptoms and blood in the stools. If these criteria are fulfilled, these lesions will not prove malignant, in his experience. If they do not disappear, or if they disappear all but a teat-like projection, they must be submitted to the radical procedure of subtotal gastrectomy, since under these conditions they will prove to

be either intractable ulcers or malignancy, and there is no way of telling then which is which.

Dr. J. Shelton Horsley (Richmond, Virginia) said that according to a recent census, it is estimated that there are over 120,000 deaths from cancer each year. That has almost doubled within the last fifteen or sixteen years. Of this number, approximately one-fourth are cancer of the stomach. It seems, then, that with an increasing morbidity and mortality like this one cannot emphasize the situation too much.

It is true, as Doctor Maes says, that these cases clinically are sub-divided into those that have had symptoms for some time and those that have not. He possibly underrates the importance of the laboratory diagnosis. By that Doctor Horsley did not mean necessarily blood counts or even gastric analysis, although they help. A carefully taken X-ray examination by one competent to do it is extremely valuable. If there is a gastric lesion it puts the responsibility upon the practicing physician and upon the surgeon at the same time.

As to when these gastric ulcers become cancerous, it is difficult to tell. Holmes, for instance, of the Massachusetts General Hospital, has emphasized the fact that even when one has the ulcer in the hand one cannot always tell whether it is malignant or not. The ultimate results depend largely upon an early operation, and yet there are some late cases, possibly of the colloid type, in which a late operation gives satisfactory results.

He recalled the case of a woman who had felt a palpable tumor for a year before she was operated upon. The lesion was quite extensive. Partial gastrectomy according to a modification of Billroth I was done. She made a satisfactory recovery and died three years later with metastasis of the chest. There was no clinical symptom of local recurrence, but no necropsy was done.

One other point is that gastroenterostomy holds, if any, a very limited field in cancer of the stomach. As Doctor Maes has shown, the mortality is great. In cases in which the lesion is near the pyloric end of the stomach, even if there are comparatively mild metastases in the liver, partial gastrectomy carried out probably with a local anæsthesia and with careful preliminary preparation, particularly washing out the stomach and giving one-half of 1 per cent. hydrochloric acid for two or three days, will not give a very great mortality rate. The patient will have far more comfort by removing an obstructing septic fungating lesion at the pyloric end of the stomach than he would after a gastroenterostomy.

Dr. Roscoe R. Graham (Toronto, Ontario) said that in the management of a gastric ulcer one is not so much interested in whether the ulcer will become malignant, as in determining whether or not it is now malignant. In a recent series of cases operated upon, he had been able to gain a great deal of information on this point from the site of the ulcer. In the pyloric antrum on the lesser curvature distal to the incisura 94.2 per cent. of the ulcers were histologically malignant. Proximal to the incisura on the lesser curvature only 40 per cent. of the ulcers were malignant. Thirty-five per cent. of the high-lying lesser curvature ulcers had an associated hour-glass, which confirms their benign character, as they must have been present for a very long time to produce sufficient scarring to result in an organic hour-glass.

In an analysis of all the cases of gastric ulceration which came to his surgical ward, including those which they were certain were frankly malignant, 76 per cent. of the total incidence of gastric ulceration were due to malignancy.

He had divided this series into two time periods—the first prior to January, 1927, and the second from January, 1927, to June, 1932, inclusive. In the first period, 43 per cent. of the cases were resected. Thirty-eight per cent. of these cases were resected with no assurance of cure. Five per cent., however, they felt had an assurance of cure, as indicated by freedom from metastases in the lymphatic glands. Since January, 1927, they had been encouraged to increase their efforts towards resection, and 56 per cent. were resected during this period. Ten per cent. showed very minor evidence of lymphatic

involvement, which leads them to a hope of clinical cure. This is encouraging. They have increased their efforts in resecting more advanced cases because of the fact that with no resection a miserable end awaits the patient, yet the physician is to be encouraged to send such cases for operation earlier, as they have 10 per cent. with only minor lymphatic involvement in this period, as opposed to 5 per cent of such cases in the earlier group. In other words, they have increased their chance of cure in 5 per cent. of the cases in the second group.

Gastroenterostomy in their hands, with this radical attitude towards doing palliative resections in the advanced cases, has been used in a small percentage of instances. In the cases in which they have carried out a gastroenterostomy, the average duration of life has been four and a half months, with probably not more than four or six weeks of freedom from distress.

They have had a somewhat different experience from Doctor Lahey, in that they have reports from their radiologists stating that ulcers which are ultimately proven to be malignant have entirely disappeared under medical care, as far as their presence can be determined by radiological examination. Therefore it is very important that if they have, by non-surgical measures, caused the radiographical evidence of ulcer to disappear, such a patient should be brought back, preferably in four and certainly not later than six weeks after the ulcer is healed. Failure to do so will cause to be overlooked malignant ulcer, which will recur within this time.

The recognition of two types of gastric carcinoma is important: First, the massive type with great bulk and minimum ulceration: secondly, the type associated with maximum ulceration, minimum bulk, and marked peri-ulcer inflammatory reaction. It is in this latter group where the radiographical evidence of ulcer may be eliminated by non-surgical therapy, because the major factor in the ulceration is the result of the inflammatory reaction around a relatively small carcinoma. If an ulcer which has been apparently cured recurs within three months, it should be considered as a malignant ulcer, and a radical gastric resection carried out.

Dr. Howard Lilienthal (New York City) said he had just a word on recognition of metastasis. Doctor Maes stated that metastasis could not be discovered until a laparotomy was performed. There are two ways in which metastasis may be discovered before that time. One is the discovery of an enlarged subclavian triangle node in the Virchow's gland. He had several times saved patients from laparotomy by removing a carcinomatous gland in this region, having it examined and proven malignant.

Another point is the X-ray examination of the chests of these patients. Even a small metastasis in the lung can easily be found, much more easily in the lung than in almost any other part of the body and this may save the patient from an unnecessary operation.

Dean Lewis (Baltimore, Md.) remarked that the villain in this tragedy is the insidious onset and course of the disease. Many patients do not know that they have the disease until so late that the tumor is inoperable. It is still true, as stated many years ago, that the carcinoma which receives early treatment is the one at the pylorus which causes early pyloric block. In other situations the patient may have dyspepsia or some distress which he has had before and from which he has recovered spontaneously, or after having taken some medicine, patent or otherwise. He had recently operated upon an old colored man who said that he had been sick only three weeks. He asked him why he had not consulted a doctor. His reply was, "Doctor, I haven't been sick." There were peritoneal metastases with free fluid and metastases to the liver. In another recent instance he had operated upon a man with an inoperable carcinoma—inoperable because so adherent to the pancreas and the posterior abdominal wall—and this patient stated definitely that he had his first symptoms only three weeks before he consulted his physician.

Doctor Lewis had given some thought as to the ways which might be employed to increase the operability of carcinoma of the stomach, and had about come to the con-

clusion that to raise the operability much each patient would have to be provided with a doctor who would attend him constantly. Even then he was sure that there would be a high percentage of inoperability. The insidious onset and progress of the disease account to a large extent for delay. Patients don't visit doctors, as a rule, unless they are sick, and one cannot make a diagnosis unless one sees the patient.

Doctor Maes (closing discussion) said that his paper represented the population of a large general hospital as it is viewed in cross section, and it should be interpreted as another plea for the early diagnosis of cancer of the stomach. It was time for surgeons to wake up, to rely upon themselves and their clinical facilities more, to depend upon the refinements of radiological and laboratory diagnosis less. He was not decrying their worth, but he said they should not be the first consideration, nor should they be one's only guides. The safest decision is made with the abdomen open, and until one learns to operate on suspicion in this disease, and to teach the gastroenterologists and the internists to urge operation on suspicion, he shall not reduce its ravages.

Just how poor the present results are is shown by the figures in this paper. Only a fraction of the 200 patients studied in it had any chance whatsoever of cure, and until the entire mode of procedure is revolutionized, they can expect no change in those appalling conditions.

# THE TEN-YEAR SURVIVORS OF RADICAL MASTECTOMY

By Frank S. Mathews, M.D.
of New York, N. Y.

A year ago a paper[1] was presented to this Association containing the results of the operative treatment of carcinoma of the breast from 1913 to 1932, inclusive, and it has seemed desirable to present a further study restricted to the group of ten-year survivors of 1913 to 1923, inclusive. In this period of eleven years 115 patients were operated upon or, if incomplete operations are excluded, the number is 108. Of these twenty-eight have survived for periods of from ten to twenty years. The percentage of survivors of the ten-year period is just over 25 and it is interesting to see that the modern surgical results of different operators do not depart far from 25 per cent. for ten-year cures.

The surgeon, and particularly the friends of the patient, wish to know at the termination of the operation what the outlook is for life and health and in this paper we consider so far as possible the factors bearing on the prognosis, based on the work of others and a consideration of these twenty-eight cases.

*Early Operation.*—If treatment is neglected, the patients face a mortality rate of 100 per cent. Hence the sooner treatment is instituted the better the prognosis. This point needs no elaboration. But the practical point really is how are we to get the patients for earlier operation. There is considerable debate as to whether as a result of the campaign of publicity the patients are coming earlier than they did fifteen or twenty years ago. On this subject there is no unanimity of opinion. McCarty[2] has discussed this subject, using as evidence the size of the tumors of patients appearing at the clinic now and fifteen years ago. According to him, accurate measurements show no evidence that the size of the tumors coming to the clinic is less than in former years. Our own impressions are the same, based on the percentage of patients showing lymph-node involvement at the time of operation. This seems the more remarkable when one compares carcinoma of the breast with some other surgical diseases. For instance, our operations for acute appendicitis are now very largely performed within twenty-four hours of the appearance of symptoms. Twenty years ago this was certainly not the case. In looking over the list of thirteen carcinomas of the breast operated on within the last year, we find that ten of the thirteen showed glandular metastases. One patient had bilateral carcinoma; another carried the disease during the nine months of pregnancy; a third had a sloughing tumor scarcely suitable for palliative surgery; a fourth sought operation when axillary nodes were detected, no tumor having been detected in the breast; a fifth had a large tumor with involved glands and peau d'orange over the growth. Perhaps two

cases might be spoken of as fairly early. The cases of 1913 could have made no worse showing. Sometimes the delay is to be credited to the patient and perhaps necessarily as in the case in which the patient felt an axillary mass but could detect none in the breast. The physicians come in for their share of criticism. We do not blame them for their inability to diagnose early carcinomas especially when their type of practice leads them to see breast tumors infrequently, but what is shocking is that the physician, knowing himself inexperienced, is willing to assume the responsibility for observing these patients over varying periods until the diagnosis becomes conclusive. It may be that they go to their text-books of surgery and see pictures showing swollen arms, large and ulcerated tumors, carcinoma en cuirasse in general terminal conditions, the text-book not even mentioning that the breast cancers with which we can best surgically contend will show nothing in a picture. Strange to say, the private patients are not as a class arriving much earlier than the clinic ones. Some of the early cases come from the clinics and are discovered by the younger men of either medical or surgical training who have been disciplined in the making of routine thorough examinations. Another cause of delay is due to the submission of some of the cases to a trial of radiotherapy.

*Functional Activity of the Breast.*—At times it has been tacitly assumed that functional activity of the breast is detrimental and may in some way be concerned in the origin of a breast cancer. Lane-Claypon[3] has investigated the subject statistically. She says: "We may therefore conclude that the fertility of the patients in the present investigation is definitely lower than for non-cancerous patients." Summers[4] believes that carcinoma of the breast is proportionately more common in single than in married women of the cancer age and presents evidence based on a consideration of statistics showing the number of single and married women over thirty-five years of age in Pennsylvania. He has compared these with the deaths in the state from breast cancer and finds the single patients contributing a disproportionately large number of the total deaths. Among our twenty-eight survivors of operation 50 per cent. are known to have been single or married and childless and information is lacking regarding some of the rest. The statistics mentioned and our own would suggest that the child-bearing group has an advantage from the standpoint of tendency to breast cancer.

*Prognosis as Related to Age of Patient.*—There is a rather fixed belief that cancer in general proves more malignant in young persons than in those of later years and this has been maintained in particular of cancer of the breast. Some evidence has been presented to that effect but it has seemed to me that the anecdotal method has been depended upon to a large extent instead of statistical evidence. Sistrunk and MacCarty[5] divided their 218 cases into those over fifty years of age and those under fifty years of age and they give a survival value of from five to eight years among the older group as 41.7 per cent. while the survivors under fifty years for a corresponding time was 31.8 per cent.—a very noticeable difference. Major

Greenwood[6] has analyzed 273 cases with regard to age, dividing the patients into ten-year groups beginning at twenty-five years, and he finds no great difference in the length of life among the younger, his conclusion being: "It will be seen that either there is no significant relation of age at onset and duration of life or at least these data are not numerous enough to establish it." Lane-Claypon[3] has studied 2,006 cases and divides her subject into those under forty, forty to fifty-nine, and sixty or over and concludes: "The results obtained in this large series of cases show that the statement commonly made that the prognosis is worse in the young is erroneous." Lewis and Rienhoff[7] also have divided their patients, numbering 573, into decades and find the ten-year survivors in each decade about the same except that those from seventy to seventy-nine have done better than the other groups as regards survival. Table I is based on an analysis of the twelve youngest

TABLE I

| | | Age | Node Involvement | Grade | Duration of Life |
|---|---|---|---|---|---|
| Case 1 | L | 32 | Yes | I | 17 years |
| Case 2 | L | 26 | No | I | 8½ years |
| Case 3 | L | 28 | No | II | 7 years |
| Case 4 | D | 28 | Yes | III | 1 years |
| Case 5 | D | 31 | Yes | III | 3¼ years |
| Case 6 | D | 33 | No | II | 8 years |
| Case 7 | D | 28 | Yes | II | 2¼ years |
| Case 8 | D | 29 | Yes | I | 9½ years |
| Case 9 | D | 30 | Yes | II | 3½ years |
| Case 10 | D | 32 | No | II | 4 years |
| Case 11 | D | 33 | No | III | 1¾ years |
| Case 12 | D | 32 | Yes | I | 4 years |
| Average | | | | | 5.83 years |

Fifty-one cases with ages from fifty to fifty-nine lived 4.9 years average to date. Nine cases still living.

patients in my series of 230 operative cases. It shows three patients still living and an average length of life for the group up to date of 5.83 years. For comparison, fifty-three patients with ages of fifty to fifty-nine had an average length of life of 4.9 years. Nine of these patients are still living. We are not then quite in a position to compare averages in the two groups because some patients in each are still living. The former group of patients is too small to make a determination of the median length of life in the two groups of cases of much value. The median length of life for the fifty- to fifty-nine-year patients is just over 2.5 years, while seven of the twelve in the younger group have survived four years. These younger victims of cancer, then, have varied in grade of malignancy, lymph-node involvement and duration of life as have the older patients but in average and median duration of life have behaved as well or better than the older patients.

It is further of interest to note that the ten-year survivors have averaged but 48.5 years of age at the time of operation while the average for a series

of 200 patients operated upon was fifty-two. Hence the patients who have survived the longest have had an average age at operation distinctly less than the average age of all the patients afflicted with carcinoma of the breast. It is worthy of mention that there is considerable discrepancy in various groups of statistics as to the age of the beginning of symptoms of carcinoma of the breast. Daland,[8] in his series of 100 untreated patients, gives 57.5 years as the age of onset of the disease. He mentions, however, that a series of figures of fifteen surgeons gives 50.1 as the average age of onset. The average age at the time of operation in our 230 cases has been fifty-two years. It is notoriously difficult in an individual case to obtain even an approximate idea of the duration of the disease. Our point is that the average age of our ten-year survivors is 48.5 at the time of operation, which is distinctly lower than the average age of onset of the disease as arrived at in the various statistical reports. The range of age of our ten-year survivors has been from twenty-nine to sixty-nine, and by no manipulation of the facts and figures can one arrive at the impression that the prognosis is worse in the younger cases.

*Involvement of Axillary Nodes.*—Next to early operation the question of axillary-node involvement would seem to be of most importance in estimating the prognosis. In our cases the glands have been involved in 67.3 per cent. Table II brings out the importance of gland involvement very clearly.

TABLE II

*Prognosis as Related to Axillary Nodes*

33 patients without nodes
- 19 surviving ten years or over—57½ per cent
- 1 has since died

77 patients with glands
- 9 surviving ten years or over—11.7 per cent
- 3 have since died of cancer

Of the nineteen survivors without glands all but one are now living from ten to twenty years while of the nine survivors with glandular involvement, four have since died and three of them from cancer. Harrington[9] reports from The Mayo Clinic in a series of 2,557 cases that 52.9 per cent. of the patients without nodes were living ten years after operation while of those with nodes only 14.6 per cent. survived for ten years. There is no definite way of determining the average period intervening between the onset of cancer in the breast and the involvement of axillary nodes. There is no doubt, however, that individuals vary greatly in this respect. Sometimes six months has been suggested as an average time between onset and gland involvement. One thing is clinically quite certain that involvement of glands bears no definite relation to the size of the tumor. It does not depend on whether the tumor is mainly scirrhous, or medullary nor do I think that the size of the individual cells of the tumor bears any definite relation to the time of gland involvement. The largest individual cells can easily enough be transported through the lymphatics.

*Biopsy in Relation to Prognosis.*—In neglected cases, diagnosis is easy. Clinical diagnosis early in the disease is notoriously difficult. We do well to learn early in our career that we are unable to make positive diagnoses in early cases though diagnosis is of the utmost importance. In the earliest cases we have only the age of the patient and the possible skin retraction to guide us. The importance of the former is that few breast masses except carcinomata begin after the age of forty-five. We are not in position to let time decide the question nor should we do radical mastectomies on innocent growths, hence the necessity of biopsies—and by this I mean only biopsies made with the stage set for the radical operation. As time has gone on we have felt more and more the need of making the pathologist an integral part of our operating-room team. The macroscopical appearance of the tumor is usually sufficient but certainty is what is needed; hence the necessity for confirmation of clinical opinion based on frozen section diagnosis. Sometimes it is suggested that the prognosis is impaired by biopsy. On the other hand, Eggers[10] has maintained that the prognosis is improved if a discreet tumor is first widely excised preparatory to proceeding with a radical mastectomy. He thereby hopes to forestall dissemination during the manipulation incident to mastectomy. Assuming that we must do biopsies, we have to consider three procedures: incision of the tumor, wide excision, and simple mastectomy. All three of these have been resorted to one or more times in our ten-year survivors. The total number of biopsies on these ten-year cases has been 50 per cent. We would not advise incision even though the wound edges are immediately cauterized nor do we like simple mastectomies as it seems to complicate a subsequent radical operation more than a generous removal of the tumor would do. Experience with biopsies has not led to the conclusion that any harm has resulted from its employment and it seems as if it must be resorted to in all but the perfectly clear cases. Biopsy with an intervening period of days or weeks before radical mastectomy is done is undesirable from more than one standpoint.

*The Pathology of the Tumor.*—We have been accustomed to say that prognosis depends in large measure on the morphology of the tumor though nowadays we prefer to speak of the biology rather than the morphology, a consideration of the morphology being used to foretell the biology replacing the static term by a dynamic one. In past years it must be admitted that such terms as "medullary," "adenomatous" or "scirrhous" as applied to tumor have had no prognostic importance, neither were they related in any regular way to early or late lymph-node involvement. Greenough[11] has classified cases according to these characters and found them of no prognostic significance. On the other hand, the terms "gelatinous," "papillary" or "cystic" as applied to the tumor would suggest a malignancy below the average. In our twenty-eight patients surviving ten to twenty years, three are recorded as gelatinous carcinoma, one is now living, one lived ten years, another sixteen. And there are records of twenty and more years of survival. There was one of the sweat-gland type, the patient still living and well. The terms

"papillary" and "cystic" recur frequently in the reports, and "scirrhous" does also. Different portions of the same tumor may show widely different morphological appearances. On the other hand a metastasis in the glands may closely reproduce the characteristics of an original tumor. This brings up the subject of tumor grading, a subject which is still under investigation. The comparative factors are still only partly established. We have been fortunate in having the series of breast carcinomas graded by Dr. Cushman W. Haagenson, of the Institute of Cancer Research, New York. He graded the tumors of about 200 patients on whom I have operated and whose clinical history is known up to date but the grading has been done without knowledge of the clinical result till after the grading was complete. Table III shows

TABLE III

*Grade of Malignancy—Ten-Year Survivors*

| | |
|---|---|
| Grade I | 17 cases |
| Grade II | 8 cases |
| Grade III | 1 case |
| Not graded | 2 cases |
| Total | 28 cases |

especially the frequency of Grade I of malignancy and that one patient who survived eighteen years and has died of apoplexy was in the third grade of malignancy with nodes involved. Table IV shows the factors which were considered in the grading and, though Haagenson's own paper on the grading of these tumors should be referred to as giving the details of the methods, and

TABLE IV

*A Plan for the Histological Grading of Carcinoma of the Breast*

By Dr. C. W. Haagenson[13]

| | | |
|---|---|---|
| Cell morphology | Size of cells. | |
| | Size of nuclei. | |
| | Variation in size and shape of cells. | × |
| | Hyperchromatism. | |
| | Number of mitoses (average number per high-power field, 10 by 40 magnification, Zeiss). | × |
| Manner of growth of cells | Papillary character (papillary adeno-carcinoma arising in a cyst formed in a duct). | × |
| | Adenoid arrangement of cells (for form acini). | × |
| | Comedo character (growth mainly within ducts, often with central necrosis of cells). | × |
| Reaction of stroma | Secretory activity of cells (vacuoles in cytoplasm). | |
| | Fibrosis. | |
| | Hyaline degeneration. | |
| | Gelatinous degeneration. | × |
| | Lymphocytic infiltration. | |

The characters marked × are found to be the most important ones in prognostic grading.

their results, we have marked those which he has found most significant. It will be noticed that it is the characteristics of the tumor-cells rather than the reactions of the stroma which are of greater weight.

Among the twenty-eight survivors there have been nine patients who during their subsequent course have had recurrences. Four of these patients have died from carcinoma. To illustrate, a comparatively small group of patients who develop here and there metastases, usually near the first operative field, are then operated on from time to time for recurrences before exhaustion, ulceration, sepsis or internal metastases terminate the case. Only one patient of the group has died from intercurrent disease. She has succumbed within the past month, eighteen years after operation, at the age of seventy-six, from apoplexy. With few exceptions minor operations for local recurrences have accomplished little though one patient has survived her secondary operation for a tumor near the scar for ten years. It seems better to use radium or X-ray in such cases.

*Bilateral Tumors.*—There is something intriguing about the group of bilateral carcinomas. They occur in about 6 per cent. of breast cancer patients or, otherwise stated, they constitute about 9 per cent. of the total recurrences. It has impressed me that they belong to two groups. The first and larger is the group in which the carcinoma by permeation passes the middle line of the body to involve breast, skin, fascia and nodes of the opposite side—one or all. These tumors are clearly dependent upon the first tumor. The second group is no doubt smaller and impresses one as being composed of cases in which the patient develops a new tumor. Among our twenty-eight patients, four have developed tumors of the opposite breast with characteristics that make one think of new tumor. Sampson Handley[12] has called attention to cases in which the glands of the opposite axilla were involved without involvement of the opposite breast. Moreover, there is no group of so-called "trunk lymphatics" connecting the two breasts. In fact, we think of the lymphatics of the middle line of the torso as similar to the blood-vessels crossing the middle line and being in the main inconspicuous. The conditions which suggest that the second tumor is unrelated to the first are: First, the long interval between the first and second tumor; second, that there has been no evidence of recurrence on the side of the first operation; third, that the tumor at its origin has developed in mammary-gland tissue rather than in the subjacent fascia or lymph-nodes. One patient was seen eleven years after operation with a carcinoma of the opposite breast which spread to skin and axillary nodes and developed a local en cuirasse appearance. Another patient sixteen years after operation for a small carcinoma with a single axillary gland involved has four months ago been operated on by Dr. Jonathan Wainwright for a tumor fairly circumscribed in the opposite breast. Multiple carcinomata are now not infrequently recognized and they might be still more common were we more often successful in curing the first. It is a fairly general rule that locations in the body which are frequently the seat of primary growths are not the usual seat of meta-

stases and vice versa. For instance, we should not expect a carcinoma of the breast to metastasize to the lip or uterine body. A mention of two illustrative cases may not be amiss. A patient operated upon for carcinoma of the breast and with no signs of local recurrence died five years later following hysterectomy for carcinoma circumscribed in the uterine fundus. A patient with carcinoma of the cervix was operated upon seventeen years ago by abdominal hysterectomy and has this winter succumbed to thoracic metastases following a local removal of a carcinoma of the breast a year and a half previously. Moreover, though no great importance is attached to the observation, it may be said that the grading of the tumors and the characteristic microscopical picture has not always been the same in the first and second tumors.

It is difficult if not impossible to prove that carcinoma of the second breast is not a metastasis but when the interval is long and there is no sign of local recurrence, the presumption seems to favor the view of a second primary tumor. The fact that animals can be immunized to transplantable tumors would suggest that the factors of bodily resistance and perhaps a local susceptibility of tissue should be considered in these cases.

*Summary.*—The average age at which women are attacked with cancer of the breast has been variously stated at anywhere from forty-five to fifty-seven and a half years of age. The modal age of onset (Lewis and Rienhoff), that is, the year in which the greatest number of cases occur, is forty-seven, which probably is not very different from the average age of onset of the same cases as will be seen from an inspection of their graph. The average age of our cases at the time of operation is fifty-two years.

The average expectation of life if carcinoma of the breast is untreated is thirty-eight months (Greenwood) or forty months (Daland). The median duration of life (the time at which half the patients are living half dead) is less than this, and according to Daland is thirty months. The median duration of life following operation is scarcely three years though the average is considerably longer.

The abrupt fall in the percentage of survivors in the first, second and third years following operation is due largely to the lateness of operation with gland involvement of many of the cases and to some extent is due to the elimination of patients of higher grade of malignancy. About 40 per cent. of cases operated upon may be expected to live for five years and 25 per cent. for ten years. The deaths between the five- and ten-year period are mainly carcinoma and to a very small extent from intercurrent disease. If a patient survives for five years from the date of operation, her expectation of living five more is 62½ per cent., and if her nodes are not involved at the time of operation, her expectation is even greater.

The group of five- and ten-year survivors will contain some cases of each grade of malignancy and some patients with glandular involvement but the favorable results will be largely confined to the patients with Grade I tumors

as regards malignancy and who, at the time of operation, were without involvement of axillary nodes.

The younger patients, contrary to common belief, do quite as well following operation as the average patient. A few of the oldest develop a very slowly advancing type of carcinoma.

Biopsies must be done on early cases of carcinoma to prevent us from doing too much or too little for breast tumors.

Grading of tumors has developed a prognostic significance.

Gland involvement is still our most reliable factor in determining the prognosis, which is not very different from saying that the early cases do better than the later ones.

Patients may develop multiple malignant tumors either simultaneously or in sequence and it is quite likely that some of the late carcinomas of the second breast are not recurrences but new tumors.

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# THE INCIDENCE AND MANAGEMENT OF STONES IN THE COMMON AND HEPATIC DUCTS

By Frank H. Lahey, M.D.

of Boston, Mass.

Up to the year 1926 we had operated upon 619 patients for biliary-tract disease (infection and stone). In this group we opened the common or hepatic duct to remove or explore for stones in 15 per cent. of the cases. As the result of these investigations of the ducts, stones were discovered and removed from them in 8 per cent. of the cases. The mortality in this group was 5.6 per cent.

In looking over our follow-up figures at this time, I became impressed with the fact that a good many patients had persisting symptoms of cholelithiasis following cholecystectomy, due to stones being left in the ducts. We therefore began to investigate hepatic and common ducts more generally and upon less and less positive evidence of the probable presence of stones.

A table is submitted showing the gradual increase in the number of cases in which the ducts were opened, together with the percentage of cases in which stones were demonstrated and removed, and the mortality rate for each period.

| Years | No. of Cases of Duct Stones | Percentage of ducts opened | No of Stones found | Percent | Total Cases | Gall Stone Mortality |
|---|---|---|---|---|---|---|
| 1910-1926 | 96 | 15.5 | 52 | 8.4 | 619 | 5.6 |
| 1927-1928 | 91 | 32.7 | 38 | 13.7 | 278 | 1.45 |
| 1929 | 49 | 35.8 | 22 | 16.1 | 137 | 3.6 |
| 1930 | 61 | 42.5 | 30 | 21 | 138 | 2.1 |
| 1931 | 45 | 38 | 22 | 19 | 116 | 3.4 |
| 1932 | 52 | 46 | 24 | 21.2 | 113 | 1.7 |

The recent autopsy figures of Crump[1] in Surgery, Gynecology and Obstetrics as to the incidence of common- and hepatic-duct stones in gall-stone cases as demonstrated in 1,000 subjects at the autopsy table are interesting to compare with our operative figures showing the close relation of the finding of stones as demonstrated at operation and at autopsy. In this study of 1,000 consecutive autopsies on subjects between eleven and ninety-four years of age, gall-stones were found in 325 cases, and stones were found in the ducts in seventy-eight, or 24 per cent. of the cases having stones.

We must assume, I believe, from the above figures that we were leaving a common- or hepatic-duct stone in at least one in any ten cases of gall-stones upon which we operated prior to 1926. This, in my opinion, is a very undesirable situation, since a stone, particularly at the lower end of the common duct at the ampulla, is not only capable of bringing about a serious

[1] Crump, George Curtis: Surg., Gynec., and Obst., vol. liii, pp. 447–455, October, 1931.

situation, but in many of the cases it is the stone which is producing the symptoms for which the operation is done.

In an analysis of our cases of common-duct stones published in the Jour. Am. Med. Assn., November 22, 1930,[2] it was found that in 39 per cent. of the patients in whom common- or hepatic-duct stones were found and removed, no jaundice was present at the time of operation, nor was there a history of jaundice previous to operation in these cases.

A recent study of the cases in the years 1931 and 1932 showed forty-six cases in which common- or hepatic-duct stones were removed, and in 37 per cent. of these no jaundice was present either at the time of operation or in the past history.

One must conclude from these figures that the absence of jaundice is by no means a trustworthy argument against exploration of the ducts for possible stone. When in over a third of the cases in which duct stones were discovered and removed, the feature which has been considered so typical of the disease (jaundice) was absent, it becomes evident that we must frequently explore ducts upon suspicion even when no stones can be palpated in the ducts.

In over a third of the cases in which stones were demonstrated and removed but no jaundice was present, we have been unable to palpate stones at the time of operation, and the ducts have been opened and explored without any positive evidence of the presence of the stones. We have removed stones now so often from the lower end of the common duct at the ampulla in the absence of jaundice, and without being able to say definitely that they were there either from the history or by palpation of the ducts, that we are no longer surprised when a stone forcep or sucker passed down the common duct in a case in which stone would ordinarily not be suspected is withdrawn with a stone in it.

This experience has necessitated for us the establishment of a new set of criteria as to indications for opening and exploring the common and hepatic ducts when cholecystectomy is done for gall-stones. With that in mind we have formulated the following set of indications:

We believe that when cholecystectomy is being done for gall-stones, the common and hepatic ducts should be explored (1) whenever on palpation one can, or suspects that he can, feel a stone in the duct; (2) when the common duct is dilated, and when the common duct is definitely thickened. We believe that the longer infection and stones have been present in the gall-bladder, the more frequently will stones be found in the common and hepatic ducts, for which reason the ducts should be opened and searched for stones whenever the gall-bladder is found thickened or contracted. Thickening of the head of the pancreas from whatever the cause makes palpation of the lower end of the duct for stones uncertain and unreliable. In such cases, also, we believe the common duct should be opened and its lower end explored.

[2] Clute, H. M.: Jour. Am. Med. Assn., vol. xcv, pp. 1568–1570.

(3) Obviously we believe that the duct should be opened and explored in all patients with gall-stones who are or have been jaundiced.

We do not wish to present any extensive discussion of operative procedures to this experienced audience. There are, however, certain technical

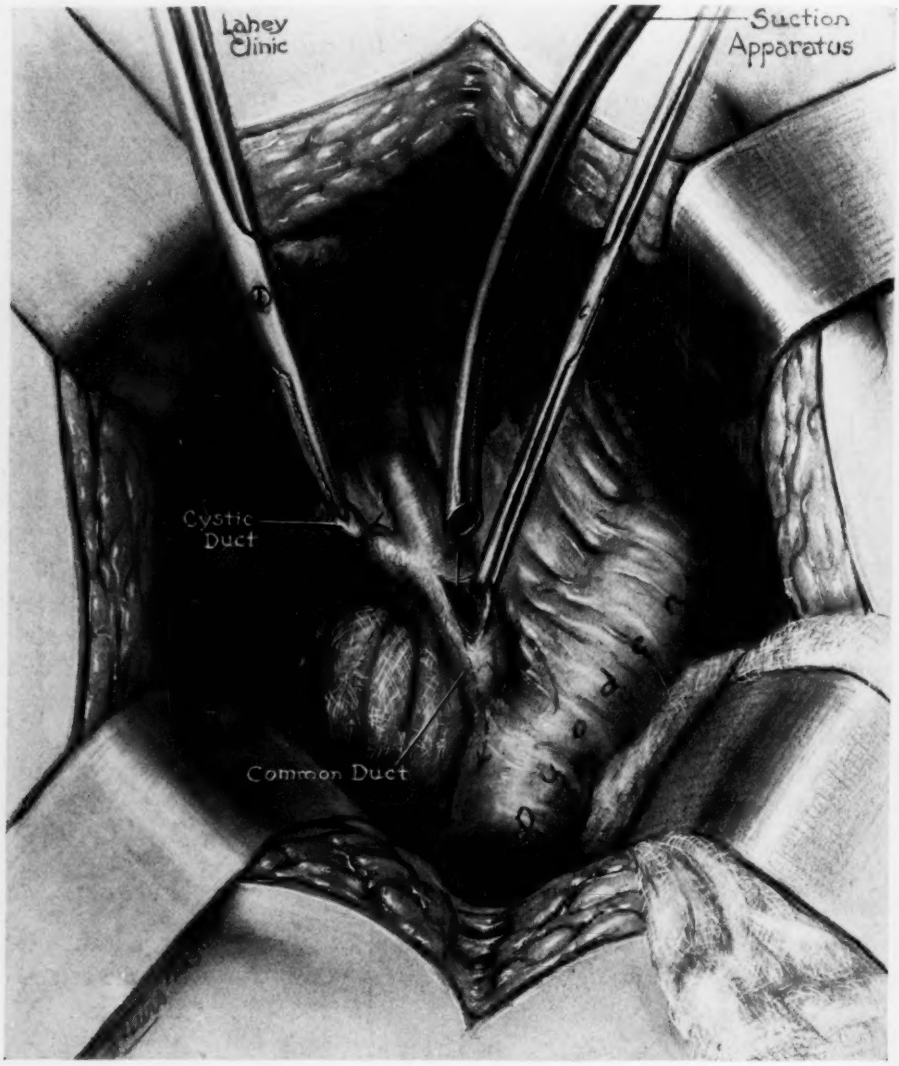


FIG. 1.—Showing the large opened end metal suction tube to be passed down the common duct to the ampulla where stones are so commonly overlooked. Note the packing which walls off the foramen of Winslow and also catches any infected material coming from the common duct when it is opened. With proper suction technic there should be no contamination of the subhepatic spaces with this material, one of the causes of subdiaphragmatic abscess.

procedures which have proven valuable to us in this operative experience with 197 proven cases of common- and hepatic-duct stones.

The safest and most satisfactory way to remove stones from the common duct at the ampulla of Vater, where they are most commonly overlooked, is

by passing instruments through the incised common duct down to the ampulla and withdrawing the stones through the duct. When this is possible —and it usually is—it is a much safer procedure than transduodenal choledochotomy or rotation of the duodenum and incision of the duct on the posterior wall of the duodenum.

Large stones lodged at the lower end of the duct usually cause marked dilatation of the ducts, and so make demonstration of the stones and their removal through the ducts relatively easy.

It is the small stones lodged at the lower end of the ducts which are so often overlooked, in our experience, and it is these cases in which the employment of suction has proven so valuable.

We have for the past few years passed a large open-ended metal suction tube, as shown in Fig. 1, down to the ampulla, and in many of the cases

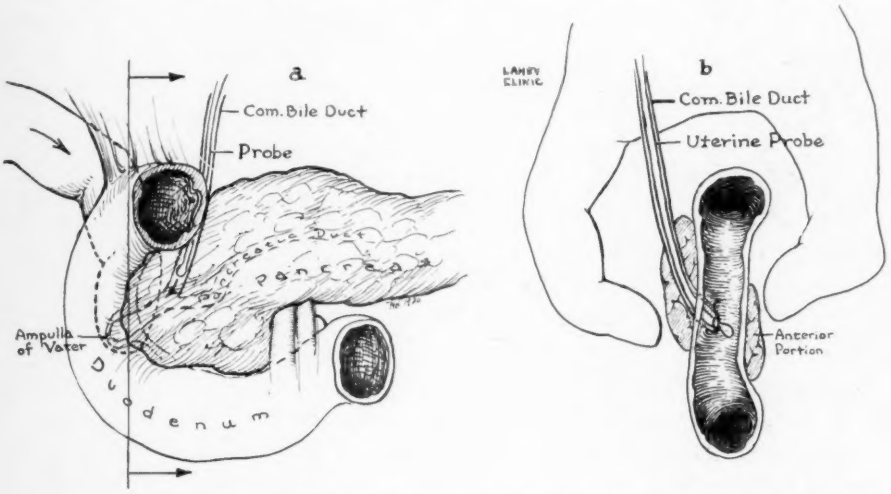


FIG. 2.—The plan of passing a uterine probe *a* down the common duct into the duodenum *b* and the demonstration of stones at the ampulla by palpating them *b* on the obturator.

successfully extricated small stones with it. This scheme has proven valuable in the removal of small stones which might or might not pass, but when possible are better removed.

Another method of determining the posible presence of small stones at the lower end of the duct which has proven helpful to us is by passing a uterine probe down to and, if possible, through the ampulla. Palpation upon the probe as shown in Fig. 2 will then sometimes permit one to feel the small stone as it is palpated against the obturator within the duct.

One of the most difficult decisions to make in patients suspected of having common-duct stones is to advise operation on the unjaundiced patient who has had cholecystectomy for gall-stones, but who still has pain, which is suspected of being gall-stone colic. In such cases one constantly has in mind how chagrined he will feel to have put such a patient through another operative procedure if exploration of the ducts at the second operation proves negative for stone. It is in these patients that duodenal drainage and the

study of the sediment of the material so obtained has proven of such great value to us. Dr. Allen Wilkinson, who has interested himself in this situation, has done duodenal drainage in thirty-two patients in whom such a decision has had to be made. On the basis of the demonstration of crystals and bilirubin pigment in all of these cases, he has advised operation. Of the thirty-two cases, stones were removed from the ducts in thirty and failed of demonstration in two. The study of the sediment of the material removed by duodenal drainage (Figs. 3 and 4) has also been of great value to us in making decisions against surgery in border-line jaundiced cases without convincing evidences of stones in the ducts.

*Conclusions.*—The average incidence of common-duct stone in patients with cholelithiasis is probably in the neighborhood of 20 per cent., and in patients operated upon for cholelithiasis, explorations of the ducts should

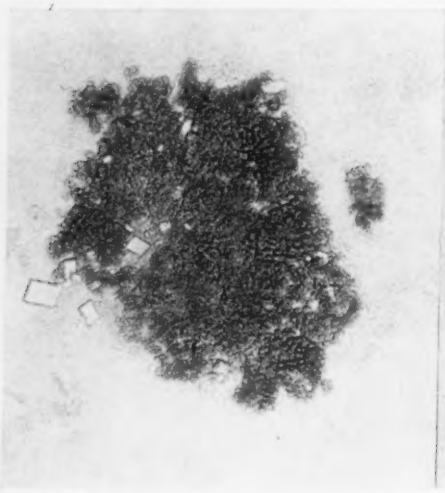

FIG. 3.—The duodenal drainage sediment in a patient suspected of and proven at operation to have common-duct calcium stones. This sediment consists of calcium bilirubin pigment and cholesterin crystals.

FIG. 4.—Cholesterin crystals and traces of pigment in a patient suspected of and proven at operation to have a cholesterin common-duct stone.

demonstrate stones in percentages which at least reasonably approach this figure if we wish to remove all of the stones.

A study of the sediment obtained by duodenal drainage is of value in suggesting the possible presence of common-duct stone.

The absence of jaundice and the inability to palpate stones in the ducts are not reliable indications that stones are not present in the lower end of the duct. Criteria for opening the duct are suggested.

DISCUSSION.—DR. DAVID CHEEVER (Boston, Mass.) said that some three years ago he wrote a brief note in the Archives of Surgery on the instrumental dilatation of the duodenal papilla in order to secure the passage of small calculi into the duodenum. He there called attention to a simple procedure to which he did not attach very much importance because he supposed that it was so obvious that everybody practised it, but in going about the country to various clinics he very seldom saw the expedient practised so that he thinks possibly it is worth while to call attention to it.

The duodenum, the gall-bladder and biliary ducts unite to form the common duct which passes down behind the second portion of the duodenum and expands into the ampulla of Vater just before it finally empties by the papilla.

A longitudinal incision may be made in the common duct and an effort made to remove with a flexible scoop any calculus which may be present; or if this fails, to milk it up to the incision. If these measures are unsuccessful an ordinary flexible woven silk, olive tipped, hollow urethral bougie is passed into the common duct and down into the duodenum. It is his clinical experience that a No. 10 French bougie represents the normal calibre of the papilla. It is perfectly obvious that if one injects a sterile solution such as saline solution through this hollow bougie, if the tip has not entered the duodenum the fluid will flow back around the bougie and out through the incision in the duct into the depths of the wound whence, of course, it must be aspirated; whereas if the tip of the bougie is in the duodenum the fluid will pass into the gut and there will be no reflux. Having by this test proved that the tip of the bougie with its lateral fenestration is in the duodenum, the instrument is then very gradually withdrawn while the operator at the same time keeps up the injection of fluid watching carefully the incision in the common duct in order to note the first appearance of reflux of fluid which, it is evident, must indicate that the fenestration in the bougie has been withdrawn to a point where it is just within the opening of the papilla. It is usually best at this time to stop the injection, fill the syringe again in order to have ample fluid at disposal, and then inject smartly at the same time rapidly withdrawing the bougie. It is evident that this strong jet of fluid is necessarily exerted and makes pressure beyond any calculus and débris which may lie in the ampulla of Vater and consequently such bodies, as the bougie is withdrawn entirely, are floated up into the accessible part of the common duct whence they may be easily removed.

He had repeatedly used this manœuvre to float calculi up into the visible part of the common duct. It is a perfectly obvious and simple expedient.

In conjunction with this method it has been his practice purposefully to dilate the papilla with graduated woven silk bougies up to Nos. 12, 14 and occasionally 16 French, always confirming the fact that the bougie has passed through the papilla into the duodenum by the irrigation test above described. This is done in order that any small calculi or débris left in the duct may pass the more readily into the duodenum. It might be thought that a reflux of duodenal contents might occur through the dilated papilla into the duct and thus into the depths of the wound, but he had had only one patient where there was any evidence of such an occurrence and it proved to be not at all serious. However, a few cases have been reported.

Dr. John Homans (Boston, Mass.) offered a suggestion concerning the cystic duct. Sometimes if the cystic duct is particularly long and runs down the side of the hepatic, it may pass nearly to the duodenum before joining it. In one case he found stones impacted in the lower end of the cystic duct which a scoop or any form of suction would have failed to discover if passed into what appeared to be the common duct but which really was the hepatic.

In another case recently he found, after a previous cholecystectomy, a dilated stump of a long cystic duct and a stone in the common duct below which he was quite sure had been overlooked by the previous operator and left in the cystic duct. It had drifted down when the ducts became dilated after cholecystectomy.

Thus, whether or not the common duct is explored, it is quite worth while to find out what sort of cystic duct is left after cholecystectomy, whether there is a considerable amount below the part you see and whether or not a small stone may perhaps remain impacted there.

# THE TREATMENT OF CANCEROUS OR POTENTIALLY CANCEROUS CERVICAL LYMPH-NODES

By Vilray Papin Blair, M.D.
and
James Barrett Brown, M.D.
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From the Department of Surgery of Washington University

The opening paragraphs of this paper present a summary of our present practice in the care of possibly cancerous cervical lymph-nodes, which is based on what we believe to be competent authority and personal observations made in the care of 473 cases of true squamous or adeno-carcinoma arising somewhere above the body of the mandible, the great majority of which were situated somewhere within the mouth or pharynx.

This summary is followed by an analysis of 131 cases of oral cancer, treated before 1930, in which the related lymph-nodes were removed by a block dissection.

*Summary of Present Plan of Treatment of the Lymph-Nodes.*—In every case of true squamous or adeno-carcinoma arising on the lip, or within the mouth or pharynx anywhere below the level of the mouth slit or anywhere in the cheek lining, the attempt is made to eliminate the possibly infected lymph-nodes preferably without waiting for their metastatic infection to become evident.

Whenever it appears practical the primary growth is controlled before the attempt is made to deal radically with the lymph-nodes, but radiation is usually given to the neck areas in the hope of retarding the development of metastases while awaiting the most desirable time to do the neck operation.

In certain advanced growths it may be necessary, or seem to be better surgery, to destroy the primary growth and remove the related lymphatic nodes at one sitting, but this procedure gives a higher operative mortality.

For growths confined to one side of the mid-line and situated anterior to the foramen cæcum or the posterior faucial pillar, the removal of the lymph-nodes is limited to that side of the neck unless the other side becomes evidently involved.

When the involvement is not too extensive, the quickest and most effective way of preventing or eliminating infection of these neck areas is by a painstaking sharp dissection that removes lymph-bearing tissues *en masse*. The presence of palpable carcinomatous nodes does not preclude a fair chance of cure by a well-made dissection, but, if the gland mass has become fixed to the carotid artery, to the vertebræ or the mastoid process, to the larynx, or has gone below the level of the clavicle, then the case is not suitable for a radical neck dissection. The same is true of cases of bilateral neck invasion from a nasopharyngeal growth.

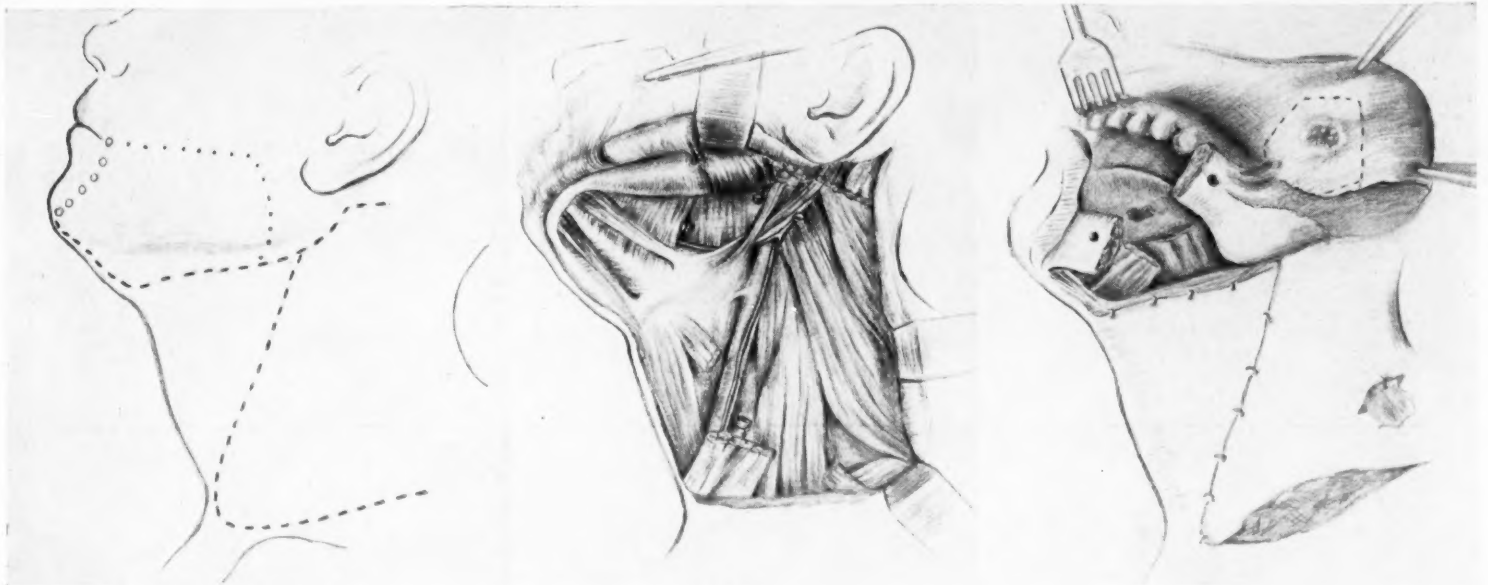

FIG. 1. FIG. 2. FIG. 3.

FIG. 1.—Shows incisions used for approaching the lymph-bearing areas of the neck and for making a combined removal of the primary growth of the gum, palate or cheek, with the related lymphatics. The dashed line is the approach for a complete removal of the submental, submaxillary, buccal and deep cervical lymphatics. The line of circles through the full thickness and the line of dots through the mucosa, in conjunction with the upper transverse part of the incision, is used to retract the cheek for a wide simultaneous exposure of the buccal cavity and the upper half of the neck. (See Fig. 3.) The above exposure in conjunction with a section through the mandible in front of the angle gives a better approach to the posterior part of the mouth.

FIG. 2.—Diagrammatic representation of the operative field after complete radical removal of the lymphatic-bearing tissues of one side and here carried past the mid-line in the submental region. For speed of operating and also better removal, the sternocleidomastoid and the omohyoid muscles, the descendens hypoglossi and spinal accessory, and the superficial cervical plexus of nerves, jugular vein, submaxillary salivary gland and possibly the lower one-third of the parotid gland are removed as part of the block excision.

FIG. 3.—Shows a plan for the simultaneous elimination of the lymphatics of the neck and destruction of a growth that had originated in the cheek, but, at the time of operation, involved also the alveolar process, the neighboring part of the tongue and the posterior submaxillary lymph-node.

After completing the neck dissection and establishing drainage, the lower incision was sutured and above, the edge of the flap was sutured to the digastric muscle. The latter will slough where the sutures engage, but will have given protection and healing opportunity to the carotid area and the stump of the newly ligated facial artery. The incision alongside of the lip was then completed, the cheek flap elevated and the bone drilled and then divided with a Gigli saw. The cheek growth was removed with a cutting cautery, the posterior bone fragment with its attached growth was thoroughly cauterized with good-sized soldering irons, and the tongue area was treated by inserting radium needles (but gold radon seeds would have been our prefgrence). In a case in which there are not available teeth to anchor the lower to the upper jaw, any late slipping at the site of the bone cut might spell disaster. In this case the bone ends are best united with a fine lacing silver wire or loop of iron wire that brings the ends into firm contact. Then the wound is closed from the corner of the mouth to the hyoid bone and a balsam of Peru iodoform gauze pack in a tent is placed snugly in the submaxillary region so that it contacts all raw surfaces without undue bulk. This, with proper bandaging, will prevent mouth leakage for a week or more. Ordinarily, such cases are given ether for the neck dissection in preference to local or block anæsthesia. For the cautery part chloroform is substituted, the patient having been previously protected by alkalies, lemon juice and sugar. During cauterization the lungs must be protected from smoke by breathing through a large tube, one-half inch or greater, lumen placed in the pharynx; or by blowing chloroform carrying air by means of an atomizer bulb into a stream of fresh air that is pumped continuously through an intratracheal tube. Nitrous oxide oxygen administered through an intratracheal tube could be substituted.

Inoperable lymph-node invasion can frequently be controlled for an indefinite period by the direct implantation of radon or radium within the growth, by exposure to intensive X-ray after turning back the skin that covers the growth, or a combination of both of these plans.

We have not, either in our own experience nor in the literature, found evidence that there is at present any other plan of treatment of these cervical

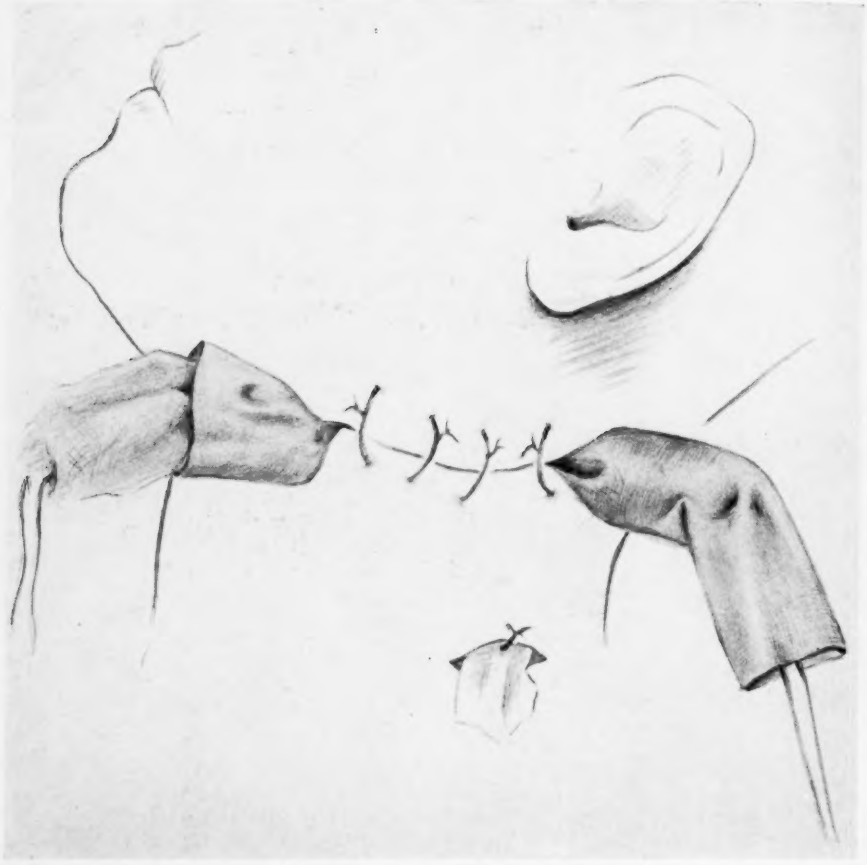

FIG. 4.—Shows a plan we have recently used when unexpectedly a cancerous gland is found attached to the carotid artery or other irremovable structure and when a radium tube is not then available. A Penfield drain, loosely distended with roled gauze is laid in contact with the remaining part of the growth. A string passes completely through the drain with the gauze roll protruding only a Ittle beyond one of the skin openings. One or several days later a properly screened tube of radium, enclosed in a gauze roll of similar diameter, is drawn into the rubber drain by means of the string and made to fit firmly against the posterior end of the original gauze roll. Then the drain with its contents is drawn forward until the radium-carrying gauze is opposite the area to be treated.

glands that has shown itself to be as sure and as lasting in its average results as the old and well-established plan of block surgical removal by sharp dissection.

Butlin,[1] following Whitehead, in 1909 summed up his personal experience with the operative treatment of tongue cancer reporting 197 operations with twenty operative deaths and fifty-five patients surviving from three to

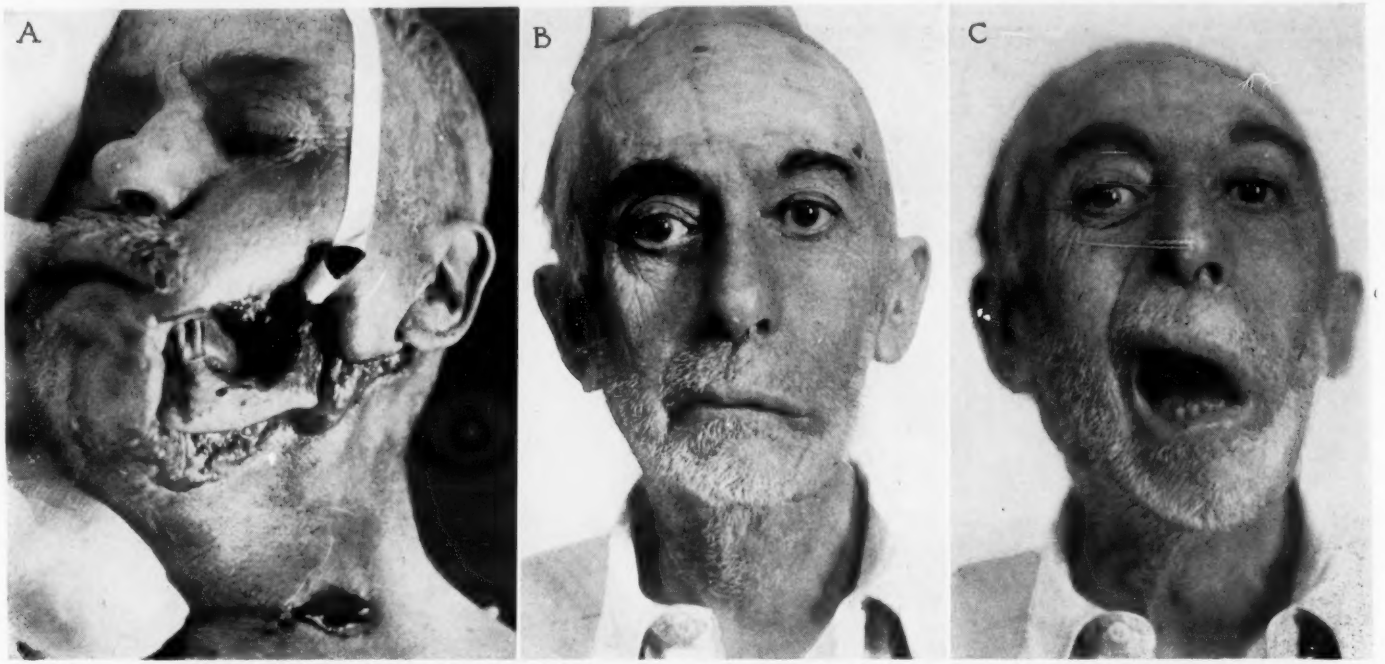


FIG. 5.—*A* shows the post-operative condition of a man of sixty-seven years who had had an extensive epithelioma of the cheek and lower jaw of three months' standing which had penetrated to the skin and invaded the submaxillary nodes. In this instance the neck dissection was carried down only to within an inch of the clavicle, as shown by the drain opening, and the lower half of the neck was closed as in Fig. 3. The submaxillary skin flap, lower part of the full thickness of the cheek, the whole lining of the cheek, the related, alveolar process of the maxilla and the full thickness of body and lower half of the ramus and mandible with the adjacent part of the floor were destroyed with hot soldering irons without previously dividing the bone. The subsequent care was simplified by the fact that we were able to preserve enough cheek tissue to allow closure of the corner of the mouth. The upper wound was cared for with an iodoform balsam of Peru tent dressing and he was fed through the esophageal tube shown in place. Microscopical examination of the glands was negative for carcinoma. Some time later a repair flap was raised from the forehead and sutured back into its original bed. Four months later, after the devitalized section of burnt bone could be separated, the repair shown in *B* and *C* was made from the forehead flap which also furnishes a complete lining to the cheek allowing the opening shown in 5-*C*.

It was Dr. Thomas Gilmer who called attention to the fact that fixing the jaws in proper relation to each other for three or four weeks after removing a full section from one-half the mandible would prevent the displacement that otherwise would render the remaining part of the lower jaw useless for chewing or proper speech.

In this particular case the jaw-bone was burnt completely through because of the extent and depth of the involvement; more frequently deep searing of the bone surface would be sufficient for control of the disease, but it is usually necessary to destroy so much of the cheek lining that subsequent scarring would lock the jaws. Complete devitalization of a full thickness section of the bone at this time later establishes a serviceable false joint when it is needed. Where the full thickness of the cheek has not been destroyed, it is a simple matter to free and unite the edges of the fistula after this bone section is thrown off.

twenty-two years—28 per cent., and analyzing the series in a number of ways that make it worth the perusal of anyone interested in this work. There was and is now great skepticism on this subject. Lack of conviction on the part of either the profession or the public that surgery can be really curative for cancer occurring within the mouth today bears the largest share of responsibility for the advanced stages at which these cases come to surgery. The relatively poor operative showing that can be made with these advanced cases in turn leaves this field open to any plan of treatment which offers any promise of hope, so long as it employs neither knife nor cautery. Within the past decade, radiation has largely predominated the field of treatment but, apparently, with a somewhat genial disregard for what good surgery has accomplished when given a fair chance. While everyone would like to see a selective agent replace mass destruction in the treatment of all cancer, and while radiation in the hands of its more skilled exponents has, in many ways, gone far in this direction, we believe that gross removal or destruction is still our most effective weapon against certain primary mouth cancers and in most of the metastases to the related lymph-nodes.

In support of the above, we venture to offer a none too brilliant showing in a small continuous series of unselected cases operated upon during a period of approximately fifteen years previous to 1930, in the majority of which some sort of radiation was also used either for the cure of primary lesion or at least as an adjunct. Our results do not make as effective a showing as did Butlin's[1] and our death rate is more than double his, but, in extenuation, we submit that but two cases in this series could be classed as early, sixteen were of medium advancement, and 113 were far advanced at the time of our first treatment. The observations of these 131 cases have been somewhat influenced by observations on more recent cases, making a total series of 473. The natural death rate of true squamous-cell epithelioma is 100 per cent., and it comes in forms that entail many months of misery and a train of social and economic disaster. If the above facts are kept in mind, the risk essential to operations of promise becomes less terrifying. No patients were subjected to special risk without having been warned and given an opportunity to choose for themselves.

*Analysis of Death Rate.*—In sixty-one cases the primary growth was first removed or destroyed and then the related lymphatic areas of the neck were removed at one or more separate later operations. In fourteen of these cases the cervical growth was so far advanced that they should have been considered inoperable; there were three post-operative deaths (4.9 per cent.) and no case lived five years. We would now exclude such cases from radical operation. In the remaining forty-eight cases in which the gland masses were not fixed directly to the carotid artery and had not grossly involved the jaw-bone, there were no post-operative deaths. In another series of seventy cases in which the growth was so far advanced as to require the removal or cautery destruction of the primary growth and the attempted radical removal of the cervical lymphatics at the same operation there were twenty-four post-operative deaths

(34 per cent.). This mortality suggests that more enthusiasm than discretion was exercised in operating on some of these cases. These twenty-four cases were all advanced cases of the tongue, pharynx and buccal mucosa, and included three common and one internal carotid ligations, ten tracheotomies

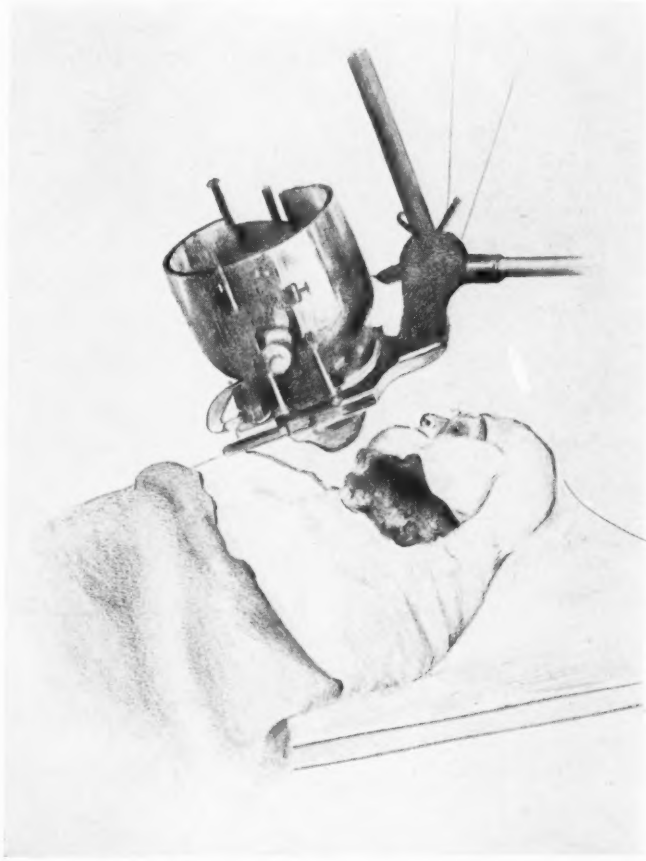

FIG. 6.—In October, 1919, we did a complete block removal of tongue, floor of mouth, submaxillary and submental regions of this patient (of sixty years) for a recurrent epithelioma of tongue, jaw and submaxillary region extending from the last right molar tooth to the second bicuspid on the left; this had been treated with X-ray for three months previously. In February, 1920, a radical dissection of the lower left side of the neck was made, and, before closing, Doctor Moore exposed the area to X-ray, while the skin flaps were still retracted. Microscopical examination of the glands showed undifferentiated squamous-cell carcinoma.

More recently in certain cases we have packed the neck open with plain gauze, covering the neck with the regular dressings before sending the patient to the Mallinckrodt Radiological Institute on his way from the operating room. A few hours or a day or so later the pack is removed and the skin wound closed by tying the sutures which are inserted at the time of operation. This patient recovered and remained well and in active business for eight years when a recurrence of a new growth appeared within the larynx from which he died in spite of a laryngectomy, which had been somewhat delayed.

and very radical procedures in all instances. Fifteen patients had definite carcinoma in the neck. The post-operative death rate of both series together is 20 per cent.

*Results of Treatment.*—In the above cases of neck dissection in which

gland masses were not fixed directly to the carotid artery and had not eroded the mandible, there is but one recorded recurrence in the neck, 2 per cent. In twenty-one of these cases the glands were found to be positively cancerous and ten patients are known to be well five to fourteen years after operation. In twenty-six the glands were reported microscopically negative and eighteen are known to be well five to eighteen years after operation.

In the series of seventy cases of combined operation, there were sixteen cures of five to eighteen years. In twenty-nine of the seventy cases the glands were apparently negative, with six cures (20 per cent.); while forty-one were definitely positive with ten cures (24½ per cent.).

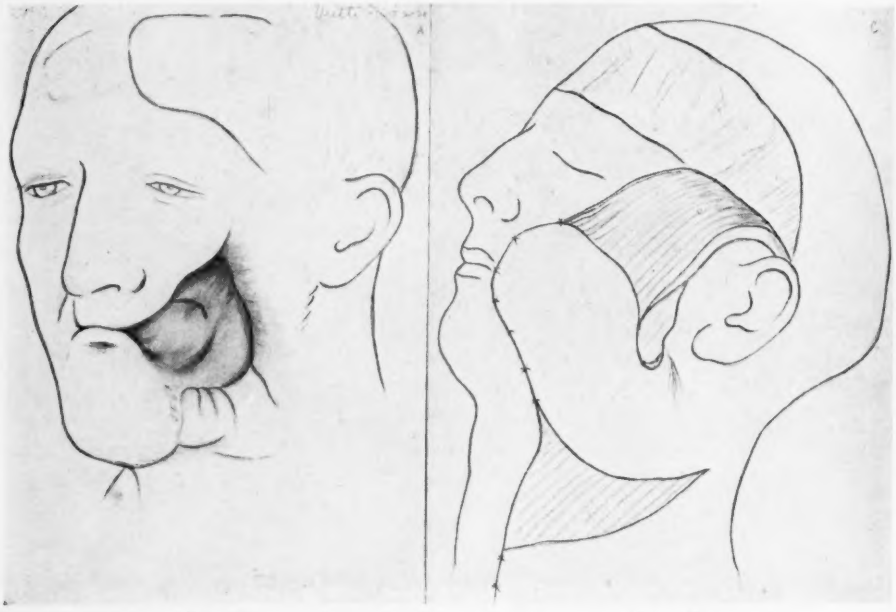

FIG. 7A. FIG. 7B.

FIG. 7.—Male who was fifty-seven years of age in 1920 when he was referred with a fungating mass three centimetres in diameter in a rough leukoplakia which covered most of the cheek lining. There was also an ulcer in inner surface of left side of upper lip. The induration extended through the lip and cheek to the skin and there was a mass of hard, related submaxillary lymph-nodes. He had consulted his physician seven months previously on account of interference with his dental plate.

*Treatment.*—One flap was raised from the forehead and one from the neck to be used for the subsequent repair. The indurated skin area was incised with a cutting cautery leaving one and one-half centimetres margin. Retraction of the borders permitted the cheek and submaxillary masses to be removed, and the exposed bone to be deeply seared with hot soldering irons. At subsequent steps the cheek defect was closed, the tissues adjusted and the lower neck dissection was completed. Microscopical examination of the glands showed undifferentiated squamous-cell carcinoma.

(*A*) shows the condition several months after removal of the growth. (*B*) is schematic diagram of the repair, using the forehead flap for the covering and neck flap for the lining.

We have not attempted to search out, combine or interpret, the statistics of published purely radiological cures, but the following suggestive results are summarized in the September, 1932, American Journal of Cancer, in an article by Mekie,[2] of Edinburgh, viz., Forsell, of Stockholm, in seventy-two cases out of 244 found definite gland involvement, and, in these seventy-two cases, he reports not one cure. Also Quick used X-ray in 161 definite gland involvements with six cures, duration not stated, which, adding Forsell's to Quick's cases, gives 233 radiated cases of known infection of the neck glands

with six cures, or 2.6 per cent. Coutard[3] reports forty-six cases of advanced clinical cancer of the tonsillar region, eighty-nine of the hypopharynx, seventy-seven of the larynx—all treated with X-ray with forty-two out of 212 (20 per cent.) well over five years. This is unique among the published records of radiological therapy for cancer of these areas.

FIG. 7C.—Shows recent photograph. The mouth opens freely. There has been no evidence of return in the operated area but in the mucosa of the lips and opposite cheek several isolated nodules have arisen at intervals which were treated with radium or removed on the presumption that they were precancerous. Some proved to have gone farther than that stage.

Compared with the above we believe our series of twenty out of seventy-four cases with secondary lymphatic metastases, 27 per cent., which were apparently well from periods of five to seventeen years after operation, is more than suggestive that there is still a place for radical surgery in the treatment of cancer of the mouth.

There is one difficulty that must be considered in attempting to make a comparison between the results of operative treatment and of radiation of the unopened neck. In a case not operated on, the interpretation of the gland condition is not as accurate as where the glands can be taken out and sectioned, although negative microscopical findings are far from 100 per cent. correct. A pertinent observation in this regard is that there occur quite a number of late manifestations of gland involvement coming on very often years after a trivial ulcer of the lip or tongue, especially the lip, had been

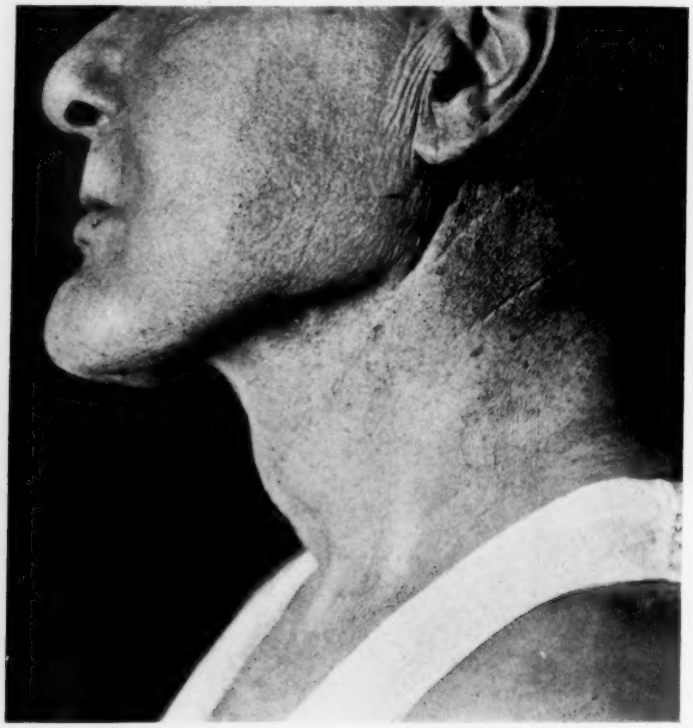

FIG. 8.—This patient presented himself eighteen years ago when forty-eight years of age with a fungating recurrence that had been present for four months. He had had the anterior half of his tongue removed for carcinoma five years previously. Excision of the tongue was facilitated by dividing the mandible through the socket of the left central incisor tooth. The amputation was made just at the hyoid bone and the actual cautery was used freely in adjacent portions of mandible, hyoid bone and pillars of the fauces. At three later steps the lymph-bearing areas of both sides of the neck and the submaxillary and submental regions were removed. Microscopical examination showed poorly differentiated squamous-cell carcinoma of the glands and in the tongue. Since recovery he has practiced his profession, taken care of a large clientele, being well understood over the telephone. His vocabulary is cut about one-third of the normal syllables. His food must be pushed until grasped by the pharynx.

cured perhaps by some application the circumstances of which the patient may have entirely forgotten until questioned. We have a record of but one case coming to us for gland recurrence in an area from which the glands had been removed *en masse*.

Mention might be made here also of two factors which we believe tend to lower the percentage of proven operative cures of cancer of the mouth in comparison with the same treatment of breast cancer. First, many of the

mouth cancers are in old and often enfeebled men who are very poor operative risks; second, the post-operative follow-up is more difficult with these men than it is with women, and their age and condition make them more liable to death from other causes before our five-year period has elapsed. Where feasible, the principle advocated by Butlin, Kocher and others of removing en masse the related lymph-nodes, without waiting for demonstrable lymphatic infection, was followed throughout, but in practice we have followed the radical technic of Crile. Butlin's analysis emphasizes the known fact that the death rate resulting from extensive surgery can often be materially reduced by dividing the operation into two or more steps.

It has been our preference where practical to postpone the neck operation a few months both to permit full operative recovery and also to get further assurance of the immediate control of the primary lesion, but at times disaster has followed this delay in spite of attempted protection by interval radiation. Butlin's figures appear to justify the practice of not always making the two operative fields continuous.

A study of the cases in this series shows that when there was a carotid ligation, associated tracheotomy, removal of a section of the lower jaw or a direct operative attack on the pharynx, operative mortality was greatest. In our present practice we attempt to avoid the above pitfalls chiefly by substituting radon or radium implantation for all primary growths arising in the tongue and floor of the mouth, fauces, pharynx and nasal passages, by using a hot soldering iron for growths involving either jaw-bone or cheek, depending upon subsequent exfoliation rather than immediate removal of the affected segment of bone. Radium can be made to destroy cancer of the bone, but the months of misery that are apt to follow when sensory nerves are not divided make destruction of the bone and its coverings with the soldering iron a somewhat acceptable substitution in most cases. We have had very poor average results with the implantation of radium within the cheek.

After destruction of squamous-cell growths occurring in the lip or mouth below the level of the mouth slit, whether by radium, cautery or removal, and for those occurring in any part of the cheek, a radical block regional glands removal is done either at the primary or at a secondary operation if the patient will submit, and if the operation looks feasible. For squamous-cell lesions above the level of the mouth slit, with the exception of the cheek lining, the gland removal is usually not urged unless cancer-like nodes are present at the time of the treatment of the primary lesion, but the patient is instructed to return for observation at regular intervals. The rather rare adeno-carcinomata and endotheliomata were treated along the same lines, but, for the lymphosarcomata and all of the primary malignancies of the lymph-nodes, no matter how named, we depend upon radiation after the diagnosis is established. These all seem to die within four years at the outside, regardless of the kind of treatment.

Thirteen years ago Dr. Sherwood Moore, Chief of the Edward Mallinckrodt Radiological Institute, first treated one of our block neck dissections,

FIG. 9.—Man, fifty-six years old, with a fixed mass in the upper part of the neck extending from the angle of the jaw to the mastoid and extending one-half way down the neck. The skin was not attached, and a very small questionable nodule just at the attachment of the anterior pillar of the tongue was present. The neck mass was uncovered by the incisions shown and the flaps turned back. He was not in good condition and his blood-pressure immediately dropped to 60/40, and for that reason a specimen was not cut from the neck but some of the outlying glands were typically carcinoma-like in their feel and contour. The main mass was fixed in the neighborhood of the bifurcation of the carotid. Six twelve and one-half-milligram needles of radium element were pushed into the deeper portion of the posterior surface of the mass and anteriorly a fifty-milligram screened tube of radium was placed deeply in relation to the carotid sheath. Long silk-worm-gut sutures were put in in such a manner that when drawn tight they would close the wound. The flaps were turned back and dressings applied. He was taken to the Mallinckrodt Radiological Institute and given the following X-ray dosage: 150 KV; 30 ma. 8 inches 1 area; 0.5 mm. copper; Port 20 cm. sq. distance 50 cm. Total dosage 125 X 8. The total radium dosage was 1,750 milligram hours. The neck was closed when the radium was removed. Microscopical examination of the nodule showed a peculiar epithelial hyperplasia but a point of breaking through was not found, and the diagnosis of cancer still rests in clinical evidence.

This photograph was taken ten days after the neck was closed, when the palpable mass was two centimetres across in its widest diameter.

while the skin flaps remained turned back so as to give direct access of the X-ray to the deeper structures. This, we have had done since sporadically, but with increasing belief as to its usefulness, and of a feeling that it could be made to reduce very materially the operative death rate of certain types of cases that help to make up the present series. (Fig. 6.) If X-ray radiation is ever to displace removal in the treatment of cancerous glands, we believe that this direct exposure will at least for a time be one of the steps in the development of the process.

Until this goal is reached, we are still convinced that, allowing for age and infirmity of the victims and given early cases, good surgery will give as good or better results and with little higher death rate than we now expect from surgery in breast cancer. All mouth cancers should receive early effective treatment, for the majority of such sufferers that we have questioned knew fairly early that something was wrong and were not slow to seek advice from the regular profession.

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# THE USE OF SILK IN THE REPAIR OF CLEAN WOUNDS

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The wound which in its repair consistently and ruthlessly measures the surgeon's skill, his self-criticism and his effort to attain the ideal, is the so-called clean wound, the wound most commonly made by the surgeon himself in his approach to and his withdrawal from uninfected and uninflamed tissues and structures.

A surgeon's percentage of clean-wound healing is not only a measure of his asepsis, but it is an index of his entire surgical philosophy—his knowledge of the principles of healing *per primam*—as well as his attitude towards his patient's welfare and towards the improvement of his art and science of surgery. This philosophy is reflected in the surgical clinic of a hospital.

The criteria of primary wound healing must be considered before discussing any technic or actual figures of clean-wound healing. Healing by primary union may be defined as the restitution of the incised tissues to their normal condition with the least possible scar, and with no discharge of any exudate from the line of incision or from any stitch holes, which either clinically or bacteriologically indicates infection.

The second essential criterion is the exact determination and recording of the healing in every clean wound. Unless this is done by a conscientious and critical surgeon and by his staff, the impressions or the casual statements made by him or his staff as to the percentage of infected clean wounds will be valueless. Unless and until such a record is kept, there will be little if any desire on the part of the surgical staff to improve their technic or to reduce their unknown percentage of infections. I speak from an experience in hospitals where no such records were kept, and where the percentage of infections was grossly underestimated; and from an experience of eight years in a clinic in which a careful record has been kept of our clean-wound healing and an annual report made, not only of the total cases on the entire general surgical service, but of the individual operators and in types of operations. This is read before the entire surgical staff. In passing, let me say that the compiling of this report (Fig. 1) is a long and difficult task, and I wish to express the appreciation of our surgical staff to Dr. Frank Meleney for his effort during the past eight years to keep up the data and to collect it annually for comparison with previous years. When this study was begun in 1925 we were amazed and chagrined to find how many more infections we had than we had estimated. Since 1925 there has been a steadily decreasing number of infected clean wounds.

Given, then, our criteria of primary-wound healing and accurate records it is possible to analyze success and failure. Such an analysis soon creates a

desire to know why some clean wounds do not heal by primary union, while the majority of others heal without evidences of infection. Of course, the prime and essential reason that the majority of clean wounds heal *per primam* in every modern hospital or clinic is because of the sterilization of the supplies, the solutions, the gowns, the gloves and the instruments that come in contact with the wound, and because of the aseptic sense that is developed in the surgical team. It is this sterilization and aseptic sense that eliminates the dreaded pyogenic and the severe anaërobic infections from our clean wounds. The above-mentioned factors are controllable and can be maintained as constant factors by eternal vigilance and supervision, and by unannounced bacteriological check-up cultures of the operating room and team. There are, however, certain mild or so-called trivial infections of clean wounds which do occur often enough to spoil the clean record of 100 per cent. clean-wound healing.

*Wound Infections—8 Years*

| | Total | Clean | % | Serious | % | Trivial | % | Tot. Inf. | % | Hemat. | % |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1925 | 558 | 482 | 86 | 20 | 4 | 56 | 10 | 76 | 14 | 27 | 5 |
| 1926 | 581 | 494 | 85 | 22 | 4 | 65 | 11 | 87 | 15 | 54 | 9 |
| 1927 | 653 | 555 | 85 | 16 | 3 | 82 | 12 | 98 | 15 | 95 | 14 |
| 1928 | 640 | 571 | 89 | 10 | 2 | 59 | 9 | 69 | 11 | 80 | 13 |
| 1929 | 771 | 703 | 91 | 17 | 2 | 51 | 7 | 68 | 9 | 141 | 18 |
| 1930 | 747 | 674 | 90 | 23 | 3 | 50 | 7 | 73 | 10 | 108 | 14 |
| 1931 | 950 | 883 | 93 | 16 | 1.7 | 51 | 5.4 | 67 | 7.1 | 97 | 10 |
| 1932 | 1053 | 997 | 95 | 12 | 1.1 | 44 | 4.2 | 56 | 5.3 | 57 | 5.4 |

Fig. 1.—Summary of annual reports showing incidence of serious and trivial infections and hematomas.

It must be evident that primary-wound healing does not depend alone upon the effort to exclude pyogenic or infective organisms. First, because wounds made in well-vascularized tissues, as in the face and neck, without any aseptic or antiseptic precautions very often heal *per primam*. Secondly, wounds closed with every aseptic precaution, but in which drains or other gross foreign bodies are present, frequently do not heal by primary union. Third, dead or compromised tissue, devascularized by crushing clamps, tight ligatures and sutures or by an obstructed blood supply acts as a foreign body and is frequently followed by suppuration in a wound closed with aseptic technic.

Furthermore, it is now well recognized that it is next to impossible to eliminate all micro-organisms, bacteriologically speaking, from the operative wound, because of the staphylococci in the sweat glands and hair follicles of the skin, and because of the organisms that circulate in the air of an

active operating room and settle in the operating field—the wound or the uncovered instruments, gauze and gloves.

Eliminating the controllable factors, heretofore mentioned, how can we reduce to a minimum the factors which predispose to the growth of the occasional pyogenic coccus or bacillus that reaches the wound either by way of the cut skin edges or, as air-borne, to the exposed instruments and supplies and gloves or directly to the wound?

First, in regard to the skin edges: I do not in any way minimize the importance of most careful preparation of the skin well beyond the operative field. By meticulous cleansing of the field, first with a grease-removing solution like ether or benzene, followed by green soap and water lathering and then rubbing with a sponge soaked in alcohol; or by the use of 7 per cent. iodine after the ether or benzene the skin can be made sterile on its surface, but not always in the deeper glands and follicles. An added safeguard is undoubtedly the careful and effective segregation of the skin edges after the incision is made, by means of dry towels or abdominal pads.

The air-borne bacteria can be minimized by careful masking of nose as well as mouth, and by covering all supply and instrument tables not in immediate and constant use by pedalled canopies. The careful masking of mouth and nose by every one in the operating room we are convinced, because of sad experience,[1] is the most important measure, for it practically eliminates air-borne but virulent streptococci from the noses and throats of the operating team.

The minimizing of foreign bodies and the minimizing of damaged tissue in the wound is the most subtle and difficult part of this subject. It deals with the essence of the surgeon's philosophy and has to do very largely with the reducing to the minimum of clean-wound infections. As we may constantly approach a limit in geometry but never reach it, so in surgery we can minimize, but never permanently eliminate, bacteria in the field. Beware of the operator who says that he never has a clean-wound infection.

William S. Halsted, that great philosopher in American surgery, many years ago discussed this subject and proposed and carried out certain principles in technic which gave him results that have probably never been excelled in clean-wound healing. His few selected and trained assistants, who later developed clinics of their own, followed these same principles. Many others attempted to use this technic, but because of poor results gave it up. The report[2] of his first year's work, which appeared in the Johns Hopkins Hospital Reports for 1890–1891, is an amazing example of accurate observation and constructive surgical teaching. Halsted elaborated and refined the technic which he had learned from Kocher, and so clearly analyzed it that any thoughtful surgeon could understand and appreciate the rationale of his meticulous handling of the clean wound. He stressed absolute sterilization of instruments and supplies, as careful cleansing of the skin of the operative field as possible, and finally the minimum of damage to the tissues in the operative field and to the wound edges. To accomplish the last desideratum he insisted

upon sharp-knife dissection; complete hemostasis with sharp-pointed artery clamps; the avoidance of mass ligatures of tissue; the avoidance of undue tension on the sutures. Because catgut was so difficult to sterilize at that period and because its absorbability was so uncertain he adopted silk in its finest grades as the optimum material for sutures and ligatures. He found that the use of fine silk improved his wound healing, made his staff more self-critical and favored the accomplishment of the principles essential to clean-wound healing.

The use of fine silk has come to be accepted as the standard in neurological work, where clean-wound healing is rightly considered essential. It is used in many clinics for the thyroid and bone and joint surgery, and yet

*Summary of Tensile Strengths of Laparotomy Wounds in Rat*

| Day | Catgut | Silk |
|---|---|---|
| 6 hours | 20 | 27 |
| 2nd day | 25.2 | 33.6 |
| 4th " | 17.5 | 30.0 |
| 6th " | 68.08 | 98.68 |
| 8th " | 70.73 | 108.61 |
| 10th " | 87.21 | 140.76 |
| 12th " | 101.74 | 175.95 |

In all instances in catgut, wounds broke, not the surrounding tissue, up through the eighth day when break was through surrounding tissue from the ninth day on. In case of silk, surrounding tissue broke from the seventh day. Tearing of actual suture line was up to the sixth day.

FIG. 2.—Summary of tensile strengths of parallel right rectus incisions in varying days of healing in a rat.

catgut continues to be used by the majority of surgeons in the repair of the ordinary clean wounds such as hernia, mastectomy and neck dissections.

Silk must not be used unless the surgeon is willing to carry out certain rigid rules in technic. Errors to be avoided are:

(1) Tight sutures. (2) Mass ligatures. (3) Blunt scissors dissection. (4) Careless hemostasis with blunt-nosed hemostats. (5) The use of any but the finest grades of silk. Silk that will not break should not be used. (6) The combination of silk and catgut. (7) The use of silk in any but a sterile field. (8) Continuous sutures.

Silk technic should not be introduced into a clinic for general adoption until the operators have been trained individually in its use. Unless this is done there will be disappointing results, due to faulty technic.

I was not trained in the use of silk technic in my earlier years, but I had

always admired the Halsted school for its contributions to the subject of primary-wound healing. Ten years ago I made the mistake of urging several members of our surgical team to adopt silk technic. Because we did not use the finest grades of silk, ligatures and sutures were tied with too much force; and because of a few infections which were followed by sinuses and long periods of silk extrusion we abandoned its use. Three years ago I adopted

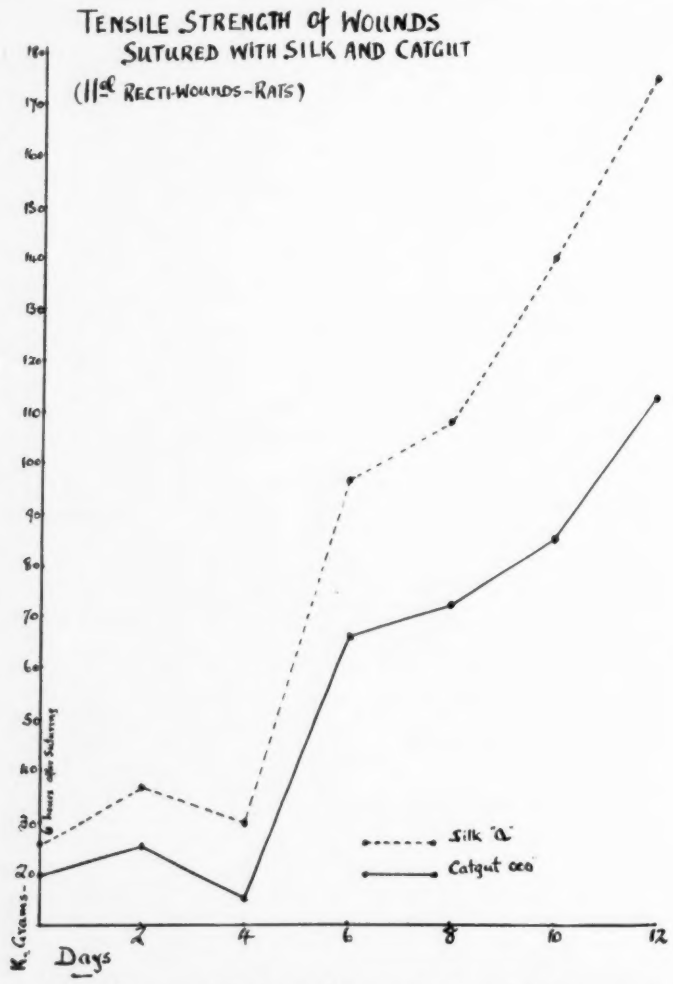


FIG. 3.—Graph representing the relative strength of parallel right rectus incisions in rats sutured with silk and catgut.

a corrected technic in my own cases, and later three of our staff began using silk technic in the thyroid and hernia work. Our next annual report showed such a marked improvement in our clean-wound healing that there was a general desire to use it on the part of the other surgeons. We have been careful to train the individual surgeon in its use before allowing him to adopt it as routine. The result is that we are satisfied that we are now having a much nearer approach to 100 per cent. clean-wound healing and are convinced

that our wounds are stronger and freer from later hernia formation than at any time when we were using catgut.

We have compared wound healing in animals with parallel rectus incisions of the same length, using fine catgut suture material on one side, fine silk on the other. In this way we compared heavy and fine sutures of the same and different materials. At varying periods of healing we removed the portion of the abdominal wall containing the parallel healing wounds and applied traction at the two ends to test the tensile strength of the two sides. Invariably the finer sutures gave stronger wound healing, and fine silk was always superior to heavy or fine catgut in the tensile strength of the wound as a whole. (Figs. 2 and 3.)

A study of the sections of these experimental wounds in different stages

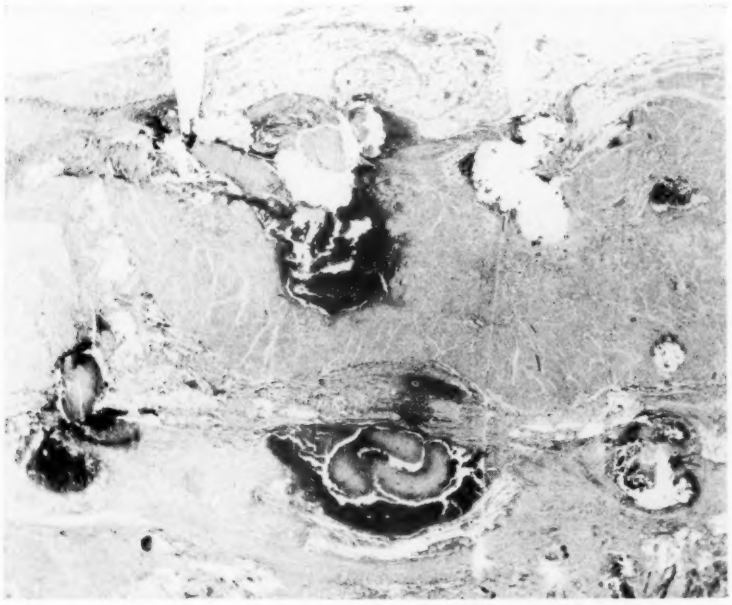

FIG. 4.—Section through rat's abdominal wall showing repair at the end of the second day. Compare tissue section about the catgut sutures on the left with the silk on the right.

of healing is most illuminating in demonstrating certain reasons for the better healing with the use of fine silk as compared to fine catgut. Undoubtedly catgut, as it is introduced through the tissues, causes more trauma because a heavier needle is required; or if the same needle is used the angle of the catgut in the eye of the needle produces a larger hole in the tissue. In tying catgut, even when every effort is made to use no more force in setting the knots than when silk is used, as was true in the making of these experimental wounds, the resulting tension on the approximated tissues bordering the sutures is greater. Pressure necrosis is certainly greater in the sections studied, as is shown by the zone of fluid and leucocytes around the catgut sutures as compared to the small zone or entire absence of it in the silk sutures. (Figs. 4 to 7.)

Another striking feature in the sections is the far larger zone of leucocytes about the catgut than about the silk sutures. This would indicate a more

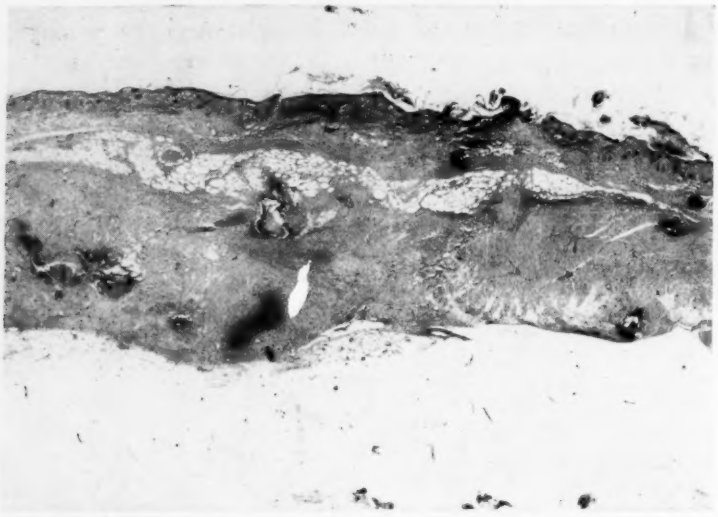

FIG. 5.—Section of rat's abdominal wall on the fourth day of repair after suture of parallel right rectus incisions. Catgut on the left, silk on the right.

irritative reaction of the tissues to catgut than to silk. In the later stages of healing, from the tenth day on, the catgut becomes absorbed, leaving a residual zone of leucocytes, whereas the fibres of the silk sutures become separated by

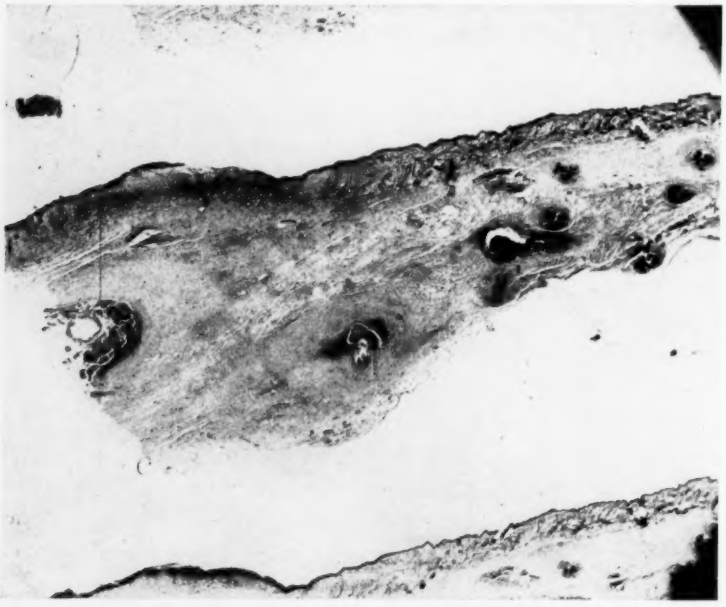

FIG. 6.—Section of rat's abdominal wall on the eighth day of repair after suture of parallel right rectus incisions. Catgut on the left, silk on the right.

infiltrating foreign-body giant cells, with a minimum or absent zone of leucocytes. (Figs. 4 to 7.)

The tables showing wounds sutured both with catgut and with silk (Figs. 8 and 9), offer an explanation for the more frequent wound infections, where these suture materials are used in combination. The dead spaces and the zone of leucocytes surrounding so many of the catgut sutures indicate low-grade infection. If non-absorbable foreign bodies, such as silk sutures, are in contact with or in close proximity to these areas of infection, a more active infection with a persistent sinus may result. Certainly in the clinical cases in our series where both catgut and silk were used, the incidence of clean-wound infection was greater than when either was used alone. Halsted

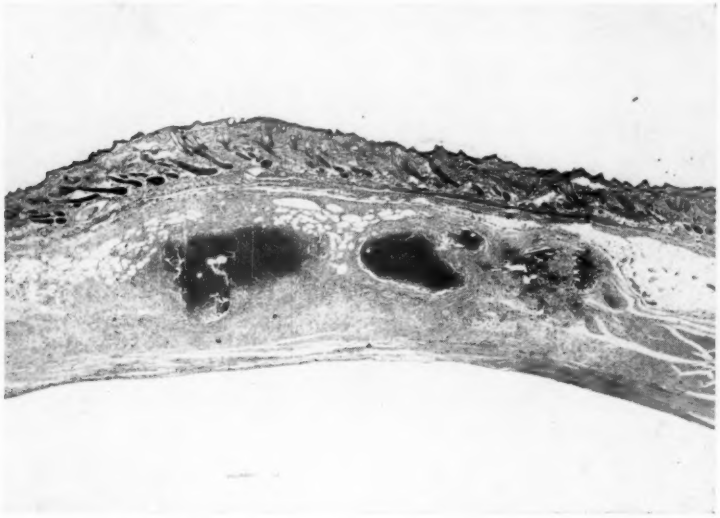

FIG. 7.—Section of rat's abdominal wall on the tenth day of repair after suture of parallel right rectus incisions. Note the almost complete disappearance of catgut and the separation of the figures of silk by infiltrating giant cells. Catgut on the left, silk on the right.

had noted this and made a categorical statement advising against using the combination, but did not offer an explanation for the poor results.

These experimental wounds will be described in greater detail by Dr. Peter J. Vivier, who collaborated with the writer in this study. They corroborate the studies of wound healing and tensile strength of wounds with various suture materials published by Howes and Harvey,[3] Howes, Sooy and Harvey[4] and more recently by Howes.[5] Many of their experiments were carried out in wounds of the stomach wall in rats where uniform conditions of manometric pressure to determine the bursting point of the wound could be maintained.

It is exceedingly interesting to watch an alert, thinking young surgeon as he develops technic and skill in the use of fine silk in his clean-wound repair. As he grasps the idea of minimum tension, minimum trauma to ligated tissue, minimum bleeding and careful knife dissection, he becomes

keenly interested and then enthusiastic over his improved results. Finally there appears a jealous care in improving his asepsis and gentleness with

*Comparison of Silk and Catgut 1930–32 in Thyroids, Hernias and Fracture Service*

| | THYROIDS | | | | HERNIAS | | | | FRACTURE | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Catgut | % | Silk | % | Catgut | % | Silk | % | Catgut | % | Silk | % |
| 1930 | | | | | | | | | | | | |
| Total | 35 | | 154 | | 84 | | 51 | | 58 | | 0 | |
| Trivial | 1 | 3 | 2 | 1 | 11 | 13 | 51 | | 3 | | - | |
| Serious | 1 | 3 | 0 | 0 | 2 | 2 | | | 5 | | - | |
| 1931 | | | | | | | | | | | | |
| Total | 1 | | 201 | | 100 | | 49 | | 38 | | 79 | |
| Trivial | | | 2 | 1 | 4 | 4 | 0 | 0 | 5 | 13 | 0 | 0 |
| Serious | | | 2 | 1 | 1 | 1 | 0 | 0 | 2 | 5 | 0 | 0 |
| 1932 | | | | | | | | | | | | |
| Total | 0 | | 286 | | 36 | | 113 | | | | 102 | |
| Trivial | - | | 1 | 0.4 | 2 | 6 | 2 | 2 | | | 4 | 4 |
| Serious | - | | 2 | 0.7 | 0 | 0 | 1 | 1 | | | 1 | 1 |

FIG. 8.—Comparison of catgut and silk technic for three years in thyroids, hernias and fractures.

tissues, and, when using catgut, an insistence upon much finer grades of catgut than those he had formerly considered essential to wound repair. I have yet

*Comparison of Catgut and Silk in the Repair of Clean Wounds*

| | Catgut | % | Silk | % | Both | % |
|---|---|---|---|---|---|---|
| 1930 | | | | | | |
| Total | 158 | | 159 | | 8 | |
| Trivial | 20 | 13 | 3 | 2 | 2 | 25 |
| Serious | 4 | 3 | 1 | 1 | 0 | 0 |
| 1931 | | | | | | |
| Total | 346 | | 354 | | 23 | |
| Trivial | 28 | 8 | 4 | 1 | 5 | 22 |
| Serious | 7 | 2 | 2 | 1 | 0 | 0 |
| 1932 | | | | | | |
| Total | 306 | | 656 | | 19 | |
| Trivial | 24 | 8.2 | 10 | 1.5 | 1 | 5 |
| Serious | 4 | 1.3 | 6 | 0.9 | 1 | 5 |
| Grand Total | 810 | | 1,169 | | 50 | |
| Trivial | 72 | 8.9 | 17 | 1.5 | 8 | 16 |
| Serious | 15 | 1.9 | 8 | 0.7 | 1 | 2 |

FIG. 9.—Summary of wound repair for three years, comparing the results with catgut, with silk, and with both in combination.

to see a carefully trained, open-minded and thinking young surgeon who, having once acquired the silk technic, does not prefer it to catgut in the repair

of clean wounds. One of our surgeons, who since has become convinced of the superiority of silk, once said: "I can't use such fine silk because it breaks constantly." Our reply was, "Don't use silk as your regular technic unless it does break."

There is this to be said against the use of silk by some surgeons. If they are overdeliberate and have any tendency to putter, the use of silk will accentuate these characteristics. One sees occasionally a surgeon, brought up in the use of silk in clean wounds to the exclusion of all other suture material, who gets lost in the ritual of silk technic and loses sight of the main issue. This Brahmin attitude is especially to be criticized in abdominal work, where prolonged operations are not tolerated as they are in the extremities or the brain. But if this tendency to waste time is guarded against, I do not believe it is necessary to take more time with silk sutures and ligatures than with any other fine material. Whatever the material, it should be used in the finest grades to get the best wound healing.

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# ACUTE POST-OPERATIVE OBSTRUCTION OF THE BOWELS DIAGNOSED BY THE FLAT RÖNTGENOGRAM

By Dudley W. Palmer, M.D.
of Cincinnati, Ohio

The diagnosis of acute post-operative obstruction of the bowel is so greatly helped by the use of the flat röntgenogram that it seemed desirable that this method and its advantages be presented to the Surgical Association as part of this symposium. It is particularly desirable that the method have your approval, as one still sees intestinal and fecal vomiting given as the signs of acute bowel obstruction, in some recent magazines and books. These *are* signs of obstruction, just as cachexia is a sign of cancer. The great need today, in the conduct of any acute bowel obstruction, is a better understanding of the earliest criteria on which a diagnosis can be made. The death rate in other forms of acute bowel obstruction is no higher, perhaps is lower, than in those obstructions following operation, and this is true in spite of the fact that this latter form of obstruction develops in the hospital and under competent supervision.

Every abdominal surgeon would feel his work had had its greatest bugbear removed, were the problems of distention, its causes, difficulties and worries, eliminated from the post-operative course of his laparotomized patient. This never will be, as long as we are unable to control, at will, the natural processes of peritoneal healing. I will not point out the many articles citing statistics, nor will I repeat individual figures giving the percentages of cases in which acute obstruction of the bowels is a cause of emergency secondary operations. The figures are appalling, the condition a calamity. Instead, I will repeat some general statements frequently made. First, post-operative adhesions are the commonest cause of acute intestinal obstruction, excepting hernias. Second, in the patient presenting symptoms of acute abdominal distress, the finding of a laparotomy scar should raise at once in the physician's mind the possibility of adhesions as the cause of those symptoms. A further fact is that with each twenty-four hours of time elapsed from the onset of symptoms of acute post-operative bowel obstruction, the death rate mounts so rapidly that it is approximately 100 per cent. at the end of ninety-six hours. Therefore, any harmless procedure that will add any detail of diagnosis or will advance the promptness of that diagnosis by even a few hours should be adopted universally.

I cannot speak for localities in which you each work, but of a few I have knowledge, and in these I know that many are not availing themselves of the aid so satisfactorily given by a flat picture of the abdomen under these conditions. Some text-book and magazine articles still do not mention the desirability of the röntgenogram in these cases of acute obstruction. I have

seen enough of the psychology of medical men, perhaps have evaluated my own mental processes well enough to know that sometimes one may develop a "mental hazard," when standing by the bedside of a patient recently operated upon. The surgeon and the medical attendant have frequently had the pleasing experience of observing how the sick patient, with symptoms suggesting obstruction, suddenly rights himself and avoids the tragedy of a secondary operation following close on the heels of a primary procedure. The trauma of operation makes difficult the proper evaluation of the post-operative symptoms and the early separation of the benign from the fatal. We have seen cases complaining of fullness in the epigastrium, of gagging, of gulping up a mouthful of clear or bile-tinged fluid, of slight distention, of nagging crampy pains at peristaltic intervals, with perhaps a slight elevation of pulse and temperature, on the one hand clear up, or on the other go on to obstruction and death. We have worried, wanted, and waited for some clinching bit of evidence. We have been inclined to procrastinate because we have known how great a shock it would be to the patient recently operated upon, and have felt the misgivings of the family when told that a second serious operation was under consideration. The combination of these facts leads to the development of the "mental hazard" and to the adoption of a course of least resistance and the decision watchfully to await developments another few hours. All this we have done in face of the fact that every surgeon academically states an acute obstruction case cannot be operated upon too soon. Under circumstances such as these, to face the patient and his family requires no inconsiderable amount of moral courage. Tangible evidence is therefore desirable.

In the modern hospital the facilities of the X-ray department are such that the patient who is the source of worry to the surgeon, because of the slightest or earliest symptom suggesting obstruction, can be easily examined. The evidence for or against obstruction can be obtained without the patient or the family suspecting there is any anxiety in the mind of the doctor or knowing what is being done. That fear can be verified or eliminated in ten minutes' time without disturbing the patient even as much as in the routine of daily care. Preparation of the patient is not required. The procedure is simple and harmless. It *is* harmful to use an opaque meal to determine the patency of the bowel in the patient with these suspicious symptoms, for thereby very minor symptoms may become tragic major ones. A portable X-ray unit is rolled into the sick-room, the patient just sufficiently lifted to slip a plate-holder under his back, and a picture snapped. Many writers advocate rolling the patient on his side to demonstrate better the fluid levels and distended loops, or sitting him upright to visualize the fluid levels. The slides to be shown are of patients after operation, taken in the patient's room with a portable machine. We have not found it necessary, for diagnosis, to add the discomfort or risk of an unusual change of position in these routine examinations. The knowledge gained is usually conclusive. It may be obtained within a few hours of the first untoward symptom. This may be twenty-four, forty-

eight, even seventy-two hours before the development of those usual text-book symptoms of obstruction that lead to an emergency laparotomy.

Experimentally, in the mechanically obstructed dog[4] gas distention of the small bowel has been demonstrated in three hours, and in three and one-half hours in the obstructed large bowel. In this experimentally obstructed gut the fluid levels were demonstrable as signs of the obstruction some three and four hours later than the gas distention evidence. Other experimental injury causing paralytic ileus produced demonstrable gas in the bowel in five and one-half hours, and fluid levels some seventeen and one-half hours after the injury. These findings correspond to the opinion of clinical workers that evidence of mechanical obstruction is earlier shown than signs of paralysis.

Points of differential diagnosis between paralysis of the bowel and mechanical obstruction are being better understood, but they are not always to be separated. Well-developed intestinal paralysis generally is thought to be a hopeless finding, but at that period when the condition is that of a paresis rather than a paralysis, much may be accomplished. The signs are definite enough for the surgeon to attack the problem of an acute post-operative obstruction before distention is a disturbing factor and even before vomiting has actually taken place. He often early can relieve himself of the worry coincident with the care of a patient who is "misbehaving" even a little, and can assure the family that things are going to come out satisfactorily sooner than if this method is not a routine one. In these cases, energetic methods directed at bowel evacuation may be persisted in with hope of great accomplishment.

The great proportion of cases of post-operative obstruction represents the adherence of some one loop of the small bowel to another area. Rather infrequently does the post-operative obstruction develop as a result of kinking or adhesions of the large bowel alone. Therefore the finding of gas in the large bowel or in the cecal head, and none in the small bowel, makes the diagnosis of an obstruction improbable. The basic principle to be observed in the examination of the flat röntgenogram of the abdomen is that in the small bowel gas is not normally to be seen, as it is intimately mixed with fluid, so in the post-operative patient, the finding of gas in the small bowel in a quantity larger than the occasional small bubble, is abnormal. There is some difference of opinion as to what is the earliest demonstrable sign in these obstruction cases. Ginzburg[3] recently said: "the earliest sign is the showing of fluid levels in the bowel." It is our opinion that the evidence of gas in the small bowel, distending even one loop, is the earliest X-ray evidence. The film may show one or several loops of small bowel distended, with serrated, ribbed, feathered, or herring-bone shadows as they are spoken of by various observers. These are the first signs and represent the valvulæ conniventes, or valves of Kerkring, and are closely placed in the small bowel. Late, the distended loop of small bowel loses these markings even though the condition was primarily mechanical. Their absence indicates a very grave prognosis in contrast to a fair or good prognosis where the evidence of muscular tone is shown by the

feathered shadows. Gas in the small bowel is centrally placed in the abdomen in the incipient stages. In a lateral view it is near the ventral surface. Later the distended small bowel may crowd the collapsed enema-emptied large bowel aside and so fill the flanks.

A little later than the "one loop" stage of gas in the small bowel, one finds the ladder pattern of Treves, an observation known long before the use of the X-ray. It seldom is seen clinically in the acutely obstructed abdomen but is definitely and routinely early seen by aid of the röntgenogram. Gas in the small bowel is in well-defined small loops whose shadows are rather uniform. Fluid in the small bowel, because of the small loops, produces short, vertical columns of fluid. An important diagnostic symptom of gas under obstructive pressure in the small bowel, is the great increase in the calibre of the bowel gas shadow. While an important sign in the making of a diagnosis, it may lead to some confusion, as these distended small bowel loops may equal the large in diameter.

In infants, the above general rules for observation of gas in the small intestine have their exception as gas normally may be seen. Nevertheless in these cases, if gas is seen in the small intestine and not in the large intestine, the probabilities are that an obstruction is present.

In contradistinction to the absence of visible gas in the small intestine, gas is a normal finding in pictures of the large bowel and stomach. Gas in the distended colon is peripherally placed on the film and there is no tendency to loop formation except of course in the sigmoid region. The gas and fluid columns are longer and more vertical when the cæcum, the ascending colon, and the descending colon areas are visualized with the patient in an erect position. The colon is further recognizable by its characteristic haustral markings, which are far more widely spaced than those of the small bowel. The globules of gas normally present in the colon are larger than the abnormal globules in the small bowel.

Combining the above general observations, the important points to be observed are that when gas is found in the small bowel it has diagnostic weight, and particularly so if there is little or no gas in the large bowel, the latter having been emptied by the enemas that usually have been given so energetically in these cases. The opposite of this is that no gas in the small bowel and considerable distention of the large bowel indicates a case in which waiting *is* justifiable, and the further use of enemas and laxatives. When a doubt exists as to the diagnosis, the picture can be repeated in six hours and the comparison of the pictures then should be conclusive as to the desirability of an operation.

Differential diagnosis is most difficult between the acute mechanical post-operative obstruction and the post-operative paralytic ileus as seen by X-ray. The difference is that paralytic ileus begins almost always as a high intestinal affair, often including the stomach, and not in the colon, so that in these cases the early gas distention is correspondingly higher. The small bowel markings are early obliterated as the bowel has early maximally relaxed and dilated.

To summarize,

First, the flat abdominal röntgenogram used in the post-operative case eliminates procrastination.

Second, in the group of cases clinically very doubtful, it can be the diagnostic factor.

Third, it offers something definite to show a family in explaining the need for a second operation.

Fourth, it enables one to avoid an unnecessary exploration.

Fifth, it is life-saving when obstruction is shown to be present before general distention and paralysis have developed.

Sixth, the method usually will locate that part of the bowel in which the obstruction has developed, thus indicating the proper place for the secondary incision and a procedure in accordance with the location.

Seventh, the findings have prognostic value.

The films shown on the screen demonstrated, first, a very early acute mechanical obstruction and the stages of its progression with less and less "feathering" up to a complete absence of these markings in the late cases of mechanical obstruction. Second, the early great dilatation in the type with obstructive symptoms associated with peritonitis and paralysis. Third, the high small intestine and gastric dilatation in the paralytic ileus group.

The films shown, with but two exceptions, have been made by Dr. Wm. M. Doughty, to whom I have been indebted for help and advice in the diagnosis of these unfortunate complications of abdominal surgery.

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DISCUSSION.—DR. DAVID CHEEVER (Boston, Mass.) remarked that in all cases the cardinal symptoms of distention, obstipation, pain and vomiting must have been present which would make a diagnosis of acute intestinal obstruction highly plausible. The stomach could be evacuated by a tube, the colon could probably be emptied by an enema and what distention remained must be of the small intestines. Thus we would get the same information afforded by Doctor Palmer's X-rays.

He raised the query whether one should not try to avoid going to the laboratory for diagnoses which might have been obvious perhaps to the old-school surgeon.

DR. ALTON OCHSNER (New Orleans, La.) said the X-ray diagnosis of ileus undoubtedly has not been sufficiently appreciated by American surgeons. In order to determine the appearance time of gas and fluid in obstructed intestine, obstructions of

various types were produced in animals. Obstructions were produced at various levels; some were of the simple variety whereas others were strangulated. They found positive röntgenographical findings earlier in strangulated obstruction than in simple obstruction. In an animal in which one hour previously a simple obstruction of the jejunum had been produced, an X-ray plate was obtained in the horizontal position (shown), whereas this was in the upright. Contrary to my previous belief based on clinical observations, gas occurred earlier than did fluid. I had formerly emphasized the importance of taking plates in the upright position in order that fluid levels might be visualized. Based upon this experimental work, however, I feel that the obtaining of a röntgenogram, as Doctor Palmer has suggested, in the horizontal position is all that is necessary because the earliest finding is gas. Doctor Ochsner presented a series of slides, one to show a fluid level in an animal one hour after the production of a simple obstruction, one to show the comparison between the horizontal and upright positions in the same animal three hours later, and one to show the difference between the simple and strangulated obstructions of the small gut. It is evident that the amount of gas and fluid present in the intestine is greater following a strangulated obstruction than following a simple obstruction. He thought, based upon this experimental work, that one is justified in saying that early in the presence of strangulation the X-ray is of value. One hour after a strangulated obstruction and three hours after simple obstruction there was röntgenographical evidence of obstruction. It is therefore of special value in those cases of strangulated obstruction, and it is, of course, the type of case in which early surgical intervention is especially indicated.

Dr. Harold Brunn (San Francisco, Calif.) said that in the X-ray diagnosis of acute bowel obstruction as shown by the dilated loops of small bowel and fluid levels in the standing and lateral position, there were two possible sources of error. One has already been mentioned in the paper which is the occurrence of the same picture in an adynamic ileus resulting from some other conditions where operation may not be indicated, and secondly in any case of gangrene of the bowel which sometimes comes on very suddenly as the result of a band compressing the vessels of the mesentery. In such cases it is possible not to have the usual dilatation of the bowel above the point of obstruction, or of the gangrenous bowel itself. He had had such a case where the diagnosis of obstruction was eliminated because the X-ray plate did not show the usual picture. Doctor Robinson, of Santa Barbara, in a similar case of gangrene, where some twenty-four inches of bowel were involved, noted also at operation that the bowel above the obstruction was not dilated. Wangensteen, of Minnesota, has done some experimental work on animals along this line which verifies to a certain degree this fact. It seems well that we should make note of such an important factor as this.

Dr. John J. Morton (Rochester, N. Y.) said that if the surgeon carries a stethoscope around with him he can make a diagnosis before it is necessary to call in the X-ray. One can get very definite peristaltic sounds through the stethoscope.

Sometimes an early X-ray will show a loop of a bowel with gas in it and nobody be able to determine whether it is in the large or the small intestine. In such a case, if a very thin enema is given, one can outline the large bowel and determine definitely that the gas is in the small bowel loop.

Sometimes one has a dilated stomach in the presence of a high obstruction which overlies the distended bowel. In this instance if a stomach tube is passed and the stomach emptied one can sometimes demonstrate the dilated loop by X-ray.

# THE INTRAVENOUS ADMINISTRATION OF DEXTROSE IN RINGER'S SOLUTION

## WITH PARTICULAR REFERENCE TO ITS USE IN ACUTE ABDOMINAL CONDITIONS

By J. Shelton Horsley, M.D.

of Richmond, Va.

Acute abdominal conditions occupy a prominent part in general surgical practice. They demand immediate therapy. They may be accompanied by shock and hæmorrhage with the prospects of a rapidly spreading inflammation. The differential diagnosis cannot always be accurately made. Delay in the treatment of a perforation of a hollow viscus or of intestinal obstruction is notoriously dangerous, and the mortality rate rises with delay.

Internal hæmorrhage may follow trauma with or without an abdominal wound. The differential diagnosis between shock and hæmorrhage is not always clear in the early stages. The concentration of the hæmoglobin and of the red blood-cells in shock without hæmorrhage is a very valuable laboratory sign. The fact, however, that early hæmorrhage may be combined with shock and the fall of the hæmoglobin may not be marked until the hæmorrhage has progressed rather extensively, is a source of some confusion. The danger of any operative procedure is greatly increased in the presence of shock, but in shock due to the sudden perforation of a viscus or to hæmorrhage, early operation may be imperative. It is under such circumstances that the prime consideration is the immediate maintenance of the blood-pressure by some measure that will not give late deleterious results.

In shock, whatever may be the theories as to its etiology, there is a loss of fluid from the vascular system. The endothelial lining of the smaller vessels and capillaries becomes more permeable than normal and the fluid plasma stagnates in the tissue spaces. This condition makes a lessened volume of fluid for the heart to propel, lowers the blood-pressure, and decreases the nutrition to the vital organs of the body, some of which, as the brain, are extremely susceptible to a diminution of normal nutritional processes. Low blood-pressure maintained for some time also profoundly affects the function of the kidneys and of the liver.

The introduction of fluids which do not readily exude from the vascular system but which contain foreign elements may serve the immediate demands of elevation of blood-pressure, but their later effects are sometimes disastrous. The remedy may be worse than the disease. I have had no personal experience with acacia preparations, which are occasionally lauded as being quite valuable. I have, however, used Hogan's[3] gelatin preparation. The immediate elevation of the blood-pressure and the apparent benefit to the patient were striking, but the three patients in whom it was injected eventually

died, with symptoms indicating uræmia. The gelatin preparation seems to occlude the small vessels in the kidneys. With that experience I have been unwilling to adopt for filling the vascular system preparations that would be retained but that were foreign and different in construction from what is normally found in the blood.

Matas,[6] in 1923, before the American Surgical Association, first presented his method of continuous intravenous injection of a 5 per cent. dextrose solution. He reported striking results in several cases. We have adopted this principle he established, somewhat modifying the technic, and have added to the 5 per cent. dextrose Ringer's solution, which contains sodium chloride, calcium chloride and potassium chloride. The beneficial action of sodium chloride, as in Ringer's solution, is obvious and has been demonstrated in a number of ways. The calcium chloride not only supplies the regular need for calcium, but the calcium salts stimulate the heart-beat and tend to make less permeable the endothelial cells of the capillaries, and thus to promote the retention in the vascular system of the solution that is placed in it. The potassium, while apparently not so important as the sodium or calcium, is an essential in the blood plasma and has an important part in the sequence of the stages of the heart-beat.

This combination of 5 per cent. dextrose in Ringer's solution is what might be called an artificial blood serum. The dextrose is, to be sure, in larger percentage than is normally found in the blood, but it is isotonic with the blood, as Matas and others have shown. The sodium, calcium and potassium are in practically the same proportion as found in the blood plasma.

The introduction of this fluid intravenously in acute abdominal conditions is extremely helpful in many instances. If there is shock, and the systolic blood-pressure has dropped below 90, the solution may be rapidly run in, 500 cubic centimetres or more within a few minutes, until the systolic blood-pressure has been restored to within ten or twenty points of its normal level. It is obvious that under these conditions there can be no strain on the heart which suffers from lack of fluid to propel. Then the flow is reduced to 100 to 200 cubic centimetres an hour. In the meantime, if operation is indicated it can be done while the intravenous flow goes on, giving more fluid if it seems to be indicated by the blood-pressure, and decreasing it when the blood-pressure is maintained at a fairly satisfactory level.

If the abdominal condition is accompanied by marked hæmorrhage or if the blood-pressure is not satisfactorily maintained by the solution, a transfusion of blood can be given through the intravenous cannula while the administration of dextrose and Ringer's solution is temporarily discontinued.

If the operation involves repair of a hollow viscus, it would seem satisfactory therapy to afford the injured viscus physiological rest. As the function of the stomach and intestine is to digest, propel, and absorb food, these tissues may be put at rest for some time by using intravenous dextrose in Ringer's solution, for the electrolytes in the blood are supplied by the ele-

ments in the Ringer's solution, calories are furnished by the dextrose, and water, of course, is the medium in which the dextrose and electrolytes are held. Dextrose contains high caloric values, a gram of dextrose being equal to 3.75 calories. A 5 per cent. dextrose solution given at the rate of about 200 cubic centimetres an hour for twenty-four hours will amount to 844 calories.

In cases of peritonitis or sepsis, or in dehydration, the continuous intravenous administration of this 5 per cent. dextrose in Ringer's solution for several days is often beneficial. It must be borne in mind, however, that when the blood-pressure is about normal the heart may be unduly strained by giving the solution too rapidly. Usually the flow of about 150 cubic centimetres an hour can be easily absorbed; but in the old, or in patients with arteriosclerosis or high blood-pressure, sometimes even this amount will unduly raise the blood-pressure.

Another advantage in the intravenous dextrose and Ringer's solution is the protection of the liver, particularly in acute abdominal cases in which the operative procedure may be prolonged and the anæsthetic irritating.

Althausen,[1] of San Francisco, has recently shown that, while the presence of a certain amount of glycogen is essential for hepatic function, "in diseases of the liver, insufficient gluconeogenesis causes 'internal' carbohydrate starvation, which results in a reduction of hepatic glycogen, probably largely through depletion of that part of it which serves as a storage form of carbohydrate. Both in experimental animals with hepatic damage and in patients with diseases of the liver, it is possible by administration of suitable amounts of dextrose to relieve the internal shortage of carbohydrate and, as a result of this, to bring about glycogen storage. Dextrose therapy is indicated in all cases of primary and secondary hepatic disease."

According to Althausen, dextrose seems to have been first advocated for treatment of diseases of the liver by Beddard in 1908, while Opie and Alford and Graham, independently, demonstrated that the feeding of carbohydrates lessens the susceptibility of dogs and rats to necrosis of the liver by chloroform and by phosphorus. This observation has been confirmed by others. That most general anæsthetics have an irritating effect upon the liver as well as upon the kidneys is generally known. Chloroform, which is now but little used as an anæsthetic, may induce acute yellow atrophy of the liver. In such anæsthetics as avertin, which is absorbed by the portal system and goes directly to the liver, the concentration of the anæsthetic on the liver is obvious. A moderate impairment of hepatic function is rather difficult to ascertain, whereas renal function is more readily estimated.

In a series of dogs that were somewhat susceptible to nephritis, MacNider,[5] of the University of North Carolina, has tested various solutions that might act as a buffer for the kidneys and protect them from the effects of the anæsthetic. He says: "The use of an isotonic solution of sodium chloride or of Ringer's solution in such animals rendered susceptible to an anæsthetic is of no value in protecting the kidney against the anæsthetic. These solutions are unable to influence the amount of stainable lipoid material in the kidney or to prevent an increase in its amount during a period of anæsthesia. When a 2 per cent. solution of sodium bicarbonate in Ringer's solution or a 5 per cent. solution of glucose in Ringer's solution is given pregnant animals and senile animals, they protect the kidney against the toxic action of ether and to a less extent from a similar action from chloroform. This protection is associated with the ability of such solutions to either cause the disappearance of the stainable lipoid material in the kidney or to so change it chemically that it fails to stain in its usual manner."

In a personal communication he says he thinks it is probable that there may be somewhat the same protective effect upon the liver as upon the kidneys.

Attention has been called to the protection of the liver by a dextrose solution. In emergency cases the accurate study of the functions of the kidneys and of the liver is frequently impossible. To adopt a procedure or to give an anæsthetic that may seriously damage already diseased liver or kidneys is, in some instances, merely postponing a catastrophe. In addition to meeting the requirements of the immediate treatment of shock or hæmorrhage, it is also necessary that consideration be given to the delayed effect of the emergency and its treatment upon the kidneys and the liver.

The excellent work of Orr and Haden[2] has shown the remarkably beneficial results of the intravenous injection of sodium chloride in obstruction of the upper gastro-intestinal tract, which is a frequent cause of acute abdominal conditions. They have demonstrated that sodium chloride is far more effective in raising the blood chlorides than any other chloride. In such cases an additional amount of sodium chloride may be readily added to this solution, though in obstruction of the lower ileum or colon this additional chloride of sodium is not always necessary, though it is a marked peristaltic stimulant. Of course the definite need for additional sodium chloride must be determined by a blood analysis, though when a patient who is frequently vomiting gives evidence of high obstruction it is well to assume that there is a chloride deficit and to add an additional amount of sodium chloride to the dextrose and Ringer's solution as it is flowing.

The correction of acidosis and the promotion of the function of the kidneys when uræmia seems pending is also greatly aided by this solution. In markedly impaired kidney function the dextrose solution may be increased to 10 per cent. and the salts eliminated. It is unwise, however, to adopt a hypertonic dextrose solution for an indefinite administration unless there is some special indication, as œdema. The hypertonic solution, while it carries more calories, is irritating to the vein and the more concentrated solutions of dextrose probably have some hemolytic effect upon the blood. Certainly it is simulating the natural methods of introducing nutrition to give it in small amounts continuously, unless there is an acute emergency such as œdema of the lungs or brain, when a highly concentrated solution of dextrose is quickly given.

The method that we have adopted for the continuous intravenous administration of dextrose and Ringer's solution is as follows:

We use a buret 54 centimetres long in which 100 cubic centimetres of fluid are contained in 9.2 centimetres of the length of the buret. The rate of flow is regulated by a screw clamp from 75 cubic centimetres an hour to as much as it may be necessary to give quickly, as in shock. In this way the danger of the entrance of air into the vein is largely obviated, while a constant rate of flow is maintained.

The rubber tubing should be boiled, stretched and twisted or beaten before

and after being boiled, and sterile water run through it, in order to remove deposits that may cause a reaction. New rubber tubing is boiled for an hour in a strong solution of soda, rinsed in running water and then boiled for an hour in tap water. At the end of the tube is a small connecting tip or metal adapter (nipple) which fits into the hypodermic needle of a Luer syringe. A glass tube is inserted near the end of the rubber tube.

All glass used in preparing the solution is Pyrex, and new glass is thoroughly washed before using.

To the 5 per cent. isotonic solution of dextrose of Matas, we add Ringer's solution. Distilled water not more than twenty-four hours old is used in the preparation of the solution. Doubly or triply distilled water seems unnecessary. The usual laboratory still is satisfactory. (We use a Stokes copper-lined still.) The reactions after the intravenous administration of dextrose in Ringer's solution we find are due to other things than the lack of a meticulous preparation of the distilled water. Deposits in the rubber tube, a residue of water in the apparatus after sterilizing, impurities in the dextrose, too rapid flow of the solution in patients with approximately normal blood-pressure, are the chief causes of reactions.

The dextrose sold in bulk is unsatisfactory for intravenous use. While marked "chemically pure quality," an inspection of the analysis will show the presence of dextrin, traces of iron and other impurities. The dextrose in solution in ampoules is better. We have had prepared by one of the large pharmaceutical houses an ampoule of 100 cubic centimetres capacity containing a solution of such concentration that when added to 400 cubic centimetres of freshly distilled water a solution of 5 per cent. dextrose and normal Ringer's solution is made, and is ready for immediate intravenous use. This is a simple, convenient and effective method.

After two or three days the vein becomes tender, and usually by that time the patient has had a sufficient amount of the solution for immediate needs. It is best, then, after two or three days, to remove the intravenous cannula and give the patient a rest for a day, when another vein may be utilized if necessary. In patients with large, accessible veins, and when the indications for giving the solution are for a period of not more than ten or twelve hours, a hypodermic needle is satisfactory for the intravenous administration. For this we use a No. 20 gage, stainless steel needle, 1½ inches (3.7 centimetres) long.

Dr. Guy W. Horsley[4] and I have devised a cannula which is employed when the solution is to be given for more than ten or twelve hours. This cannula measures 5.6 centimetres in length and has at its tip an oblique opening that permits it to be introduced into the vein as easily as a grooved director. Its lumen is large and clear throughout, which lessens the chances of its becoming occluded. The base of the cannula is ground to fit an ordinary Luer syringe, so by merely disconnecting the metal adapter or nipple on the tube through which the intravenous solution flows the cannula is at once available for transfusion of blood by the syringe method. After the trans-

fusion, the adapter may again be inserted into the cannula, and the flow of the dextrose and Ringer's solution can be continued.

It is important to sterilize the apparatus in an autoclave, because if sterilized in water some of the water may cling to the apparatus and produce a chill.

In the January, 1931, number of the Archives of Surgery we published a description of this technic in which we stated that we had used it in about 750 cases with very few reactions. Since that time the reactions have been even more infrequent. During the past year, in our cases there has been no reaction due to the intravenous administration of 5 per cent. dextrose in Ringer's solution.

The apparatus is simple and avoids even the complication of the so-called "drip." The "drip" method is fraught with danger. There is the possibility of the introduction of air by the "drip" method which would be of no consequence in proctoclysis, but would carry great danger in the vein.

The temperature at which the solution is given is of little consequence, provided it is not too hot. If it enters the vein at a temperature much over what would be the normal blood temperature, deleterious effects are likely to occur. The careless administration of a very hot solution would be followed by marked hemolysis and probably disastrous results. On the contrary, the solution at a degree considerably below the normal blood temperature, if given slowly, has but little if any bad effect. Elaborate apparatus to keep the solution at a stated temperature is unnecessary, and it is extremely difficult to calculate the temperature at which the fluid enters the vein when it has to pass through a long tube and the cannula at varying rates of speed. The solution should never be poured into the buret at a higher temperature than 100°. Hanging a few hot-water bottles around the buret, or placing a hot-water bottle over the tube near the cannula is all that is necessary, and even this may be omitted.

Gage, Ochsner and Cutting[7] have shown the beneficial effect on intestinal peristalsis of insulin in dextrose solution. Their experiments seem to indicate that the intravenous injection of dextrose in 10 per cent. solution tends to inhibit peristalsis, but when insulin is given along with the dextrose peristalsis is stimulated. We think it is best as a routine to give insulin with the solution. We give with 5 per cent. dextrose eight to ten units of insulin for every 500 cubic centimetres of the dextrose in Ringer's solution, the insulin being injected into the rubber tube while the solution is flowing. This is enough to take care of some of the dextrose, and the additional insulin excreted by the pancreas will suffice for the remaining portion. It is rare, however, to find sugar in the urine after giving 5 per cent. dextrose in Ringer's solution, even when as much as 200 cubic centimetres an hour are given for more than twenty-four hours.

The objection has been raised to the use of intravenous dextrose that it calls for the secretion of an excessive amount of insulin by the pancreas, and that when the solution is discontinued this excessive secretion will produce a

hypoglycæmia. Such a condition, however, can be easily corrected in the usual way by the oral administration of dextrose in orange juice and by other measures.

In the emergencies in which spinal anæsthesia is to be used, the intravenous dextrose in Ringer's solution is very helpful. It arrests the fall of the blood-pressure, to a large extent, by increasing the flow of the solution. In such cases the intravenous cannula is more satisfactory. In emergencies in which it is necessary to run in the solution rapidly, the introduction of an intravenous cannula is better practice, though a needle may be used.

*Summary.*—The advantages of the continuous intravenous administration of a 5 per cent. solution of dextrose and Ringer's solution in emergency cases are, that the 5 per cent. solution is isotonic, that the dextrose with the electrolytes carries most of the valuable non-protein constituents of the plasma of the blood, that there is no foreign material in it, that it may rapidly fill up the vascular system and raise the blood-pressure immediately if not permanently, that it protects the liver and kidneys, and that it not only relieves dehydration and supplies the electrolytes, but provides calories.

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# SUBCUTANEOUS INJURIES OF THE ABDOMEN

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Papers have appeared from time to time during the past several years which have dealt with subcutaneous injuries of the abdominal viscera and penetrating wounds of the abdomen. During the period from 1885 to 1890 the mortality of subcutaneous injuries of the abdomen was from 60 to 70 per cent. By 1900, the mortality in this type of case had been reduced 30 per cent. Demel published a paper from Eiselsberg's clinic in 1925, which covered a period of twenty-three and one-half years, during which time 126 cases had been observed. The mortality in this series was 21.9 per cent.

The character of the force causing subcutaneous injury or injuries is extremely variable and it may be applied in a number of different ways. Some have emphasized especially the importance of the way in which the force is applied in affecting different viscera. Force applied to a circumscribed area is more apt to injure the intestine or kidney, while force which is applied more diffusely over a wide area is more apt to injure the liver, spleen, pancreas or blood-vessels. Some viscera are protected because of their anatomical position. Engorgement during physiological activity may predispose to injury, also pathological changes in the organ to which the force is applied indirectly. The viscera of the young and those which have plasticity are not as frequently injured as are those of the old, or those which, because of fixity, cannot change form or location when the force is applied.

The mortality has been reduced in the subcutaneous injuries because the possibility of involvement of the solid viscera or intestines and bladder has been so emphasized that caution is always exercised, and with increasing experience the surgeon has improved in diagnostic ability. Exploratory laparotomy is much more frequently resorted to than before, and, as a result, many injuries are recognized and repaired which formerly would have terminated fatally because of hæmorrhage or peritonitis.

In the series about to be reported there are 140 cases of subcutaneous injuries of the abdomen. Forty-five of these cases have not been analyzed, as they were treated expectantly and the injury of the abdominal viscus was not demonstrated. All of these patients had symptoms of intra-abdominal injury which were marked and serious enough to warrant hospitalization.

*Injuries of the Liver.*—In this series are twenty cases of rupture of the liver. An operation was performed on fourteen of the twenty and six of these died, giving a mortality of 40 per cent. Four patients were not operated on because of many complicating injuries. The mortality, then, in the twenty verified cases of rupture of the liver was 50 per cent.

How extensive the injuries may be is indicated by the history of one of the cases admitted to the hospital in the early 'nineties. The patient was a forty-nine-year-old Negro who was unconscious when brought to the hospital after having been run over by a cart. The pulse was 110 and feeble, the temperature was 95.6° F. Judging from physical findings, some of the ribs on the right side were fractured. The patient soon regained consciousness, but complained of thirst, became extremely restless and the extremities were cold. The patient died seven hours after admission, not having recovered sufficiently from shock to justify any operative procedure. The autopsy revealed a rupture of the right lobe of the liver and right kidney, intra-peritoneal hæmorrhage and fat embolism of the lungs.

The histories of two cases of rupture of the liver with associated injuries follow:

CASE I.—D. T., a white male, aged thirty-four, fell into the hold of a vessel, a distance of twenty-five feet, about two hours before admission. Both femurs were fractured at the middle third, but no other injuries were discovered. The lower extremities were dressed in extension and the patient seemed fairly comfortable. The next day the temperature rose to 101.8°, pulse 120. The patient complained of severe pain in the left side. He became delirious, the temperature and pulse rose rapidly, reaching 108.8° and 170 at the time of death six days after admission. The autopsy revealed fractures of both femurs, rupture of the liver and hæmorrhage into the pleural and peritoneal cavities.

CASE II.—A. G., a white girl, aged nine years, was struck by an automobile, and when brought to the hospital was in acute distress. She complained of pain in the abdomen and left arm. The pulse was as high as 130 and almost imperceptible. Generalized abdominal tenderness, most marked in the right upper quadrant, was noted. The left humerus was fractured.

A laparotomy was performed two hours after the injury. A large laceration was found in the dome of the liver. This laceration was packed with gauze and some sutures inserted. The child recovered rapidly and completely, although some consolidation of the lung was noted and there was a pleural effusion.

The mortality of rupture of the liver is greatly increased, as may be seen by associated injuries. Edler collected 189 subcutaneous injuries of the liver and found that the mortality was 85.8 per cent. when there were associated injuries. In rupture, unassociated with other injuries, the mortality was 78.2 per cent.

The diagnosis of rupture of the liver cannot be made with certainty. A provisional diagnosis can be made when there are symptoms of internal hæmorrhage, when there are localized tenderness and rigidity in the right upper quadrant, and when the force applied has been such that rupture might be suspected. Falls from a height, the patient striking upon the feet, not infrequently cause rupture of the liver. We have not noticed bradycardia, which Finsterer regarded as a rather characteristic symptom; neither have we noted pain radiating to the right shoulder.

In all the cases the capsule of the liver was torn. The "sub-capsular rupture" with destruction of liver parenchyma described by Brandberg has not been encountered.

The treatment has consisted of packing with gauze combined with suture when sutures alone would not suffice. Gutta-percha has also been used as a drain to facilitate the escape of bile from the surface of the laceration.

The prognosis in the uncomplicated cases depends upon the early diagnosis and early control of the hæmorrhage. It is somewhat surprising that the uncomplicated cases in some statistics have a higher mortality than the complicated, for the patients are brought to the hospital later, when the injury to the abdominal wall, unassociated with other injuries, seems slight.

*Rupture of the Spleen.*—In 1928, Connors read a paper before this society in which he summarized the studies of thirty-nine cases of splenic injury. It included all injuries of the spleen encountered in the Harlem Hospital during a twenty-three-year period (1905 to 1927, inclusive). The injury was demonstrated at autopsy or by operation. In this paper it is pointed out that in the period (1906 to 1916) there were twelve admissions to the hospital for ruptured spleen, and of these twelve only three were due to automobile accidents; while in the subsequent eleven-year period (1917 to 1927) there were twenty admissions for splenic rupture and fourteen of these twenty cases were the result of such an injury.

The following cases will be cited to indicate the mechanism of rupture and the symptoms:

Case III.—This boy, aged twelve, was standing at a corner when an automobile passed. The driver leaned out of the window and slapped the boy over the left upper abdomen. The boy doubled up with pain. That night he became pale, perspired freely, suffered from abdominal pain and vomited. He was brought to the hospital thirty hours after the injury. The temperature was 100°, pulse 130, blood-pressure 110/70 and hæmoglobin 60 per cent. He complained of pain in the left upper quadrant of the abdomen, which was somewhat distended. The abdomen was generally tender, but the rigidity was most marked over the left half and dullness could be made out in the iliac fossa. Repeated blood counts revealed a falling cell and hæmoglobin count. Because of the symptoms and the character of the injury, a diagnosis of ruptured spleen was made. The abdomen was opened through a high, left, pararectal incision. A fragmented spleen was removed and the patient recovered rapidly.

Case IV.—E. J., a colored man, aged twenty-three, was struck in the lower left back by a brick about one-half hour before admission to the hospital. He experienced severe upper left quadrant pain. The temperature was 100.4° F., pulse 92, hæmoglobin 80 per cent., white blood-cells 19,250 and blood-pressure 150/88. Extreme tenderness was noted over the entire abdomen, most marked in the left upper quadrant. An operation was performed and a ruptured spleen removed.

Another mechanism of rupture is illustrated by the following case:

Case V.—T. W., a colored male, twenty-nine years of age, fell three stories, striking on a concrete pavement. When brought to the hospital the temperature was 101° F., pulse 82, respirations as high as 48, blood-pressure 115/70. There were no signs suggesting injury of the brain or cord. Pain in the abdomen increased while the patient was being observed, as did the rigidity. The symptoms as they developed pointed to a rupture of the spleen. When the laparotomy was performed a rupture of the spleen was found. A splenectomy was performed. Pneumonia developed and the patient died on the fourth day. An autopsy was performed. There were no peritoneal changes.

Extensive bronchopneumonia was found. A number of ribs on the left side had been fractured.

During the past few years several papers dealing with rupture of the spleen have appeared. The prognosis depends upon the severity of associated injuries and the time at which the operation is performed. Early diagnosis, as in most surgical emergencies, is of prime importance.

The principal symptoms are those of shock and hæmorrhage. It is often difficult to determine whether the patient is suffering from shock or hæmorrhage. Operations undertaken while the patient is in severe shock will increase the mortality, and, on the other hand, operation should not be delayed until so much bleeding has occurred that the chances of recovery are greatly reduced.

All patients complain of abdominal pain. This, in by far the greater number of cases, is in the left hypochondrium. It may, however, be generalized. Abdominal distention occurs in most of the cases. In our experience the most important points are the history of the accident, pain in the left hypochondrium, abdominal rigidity, dullness in left iliac fossa, increase in the pulse rate and a falling cell and hæmoglobin count. In suspected cases a blood count should be made on admission and repeated at frequent intervals. Other symptoms have been described, such as pain in the left shoulder, and vomiting, and considerable importance has been attached to them. These are not infrequently incidental, and undue significance should not be attached to them. In some instances the case may be regarded as that of an acute abdomen, and the rupture of the spleen is found when the abdomen is opened.

Surgical judgment must be exercised as to when an operation is to be performed. In the badly shocked case a fatal outcome may follow a poorly timed operation. Pool has pointed out that in some cases there is a distinct latent period between the subsidence of the symptoms of shock and the beginning of the symptoms of internal hæmorrhage. The operative risk will be reduced if this is kept in mind and the operation is performed in the interim (the latent period).

We much prefer removal of the spleen to suture of the rent, which is impossible in many cases, and to tamponade, which may be followed by secondary hæmorrhage. In most cases, splenectomy is as simple as either of the other procedures. The physiology is not altered and the patient, if he survives the operation, makes a complete recovery.

Spinal anæsthesia is advocated by some. We have used a combination of gas and ether anæsthesia.

There are seventeen instances of ruptured spleen in this series, fourteen of which were operated upon. Four of the fourteen patients died, giving a mortality of 28 per cent. The four deaths occurred in patients with multiple injuries. One had a ruptured lung; one a rupture of the kidney, laceration of the colon and fractured ribs; one a fractured skull, fractured femur and fat embolism; and another died on the fourth day of bronchopneumonia.

This patient also had several fractured ribs. The associated injuries were the cause of death in these cases.

The diagnosis must be made early, but considerable surgical judgment must be used in determining when the operation should be undertaken.

*Injuries of the Intestines.*—The intestines are not infrequently involved in subcutaneous injuries of the abdomen. The small intestine is more frequently injured than the large and the stomach less frequently than the large intestine. Wyss, in his paper, deals with thirty-nine injuries of the gastro-intestinal tract. The duodenum was involved in five cases, other segments of the small intestine in thirty-two and the large intestine in two cases. The force is usually circumscribed, and the patient gives a history of being kicked, struck by a stone or run over by an automobile. A bursting rupture is also occasionally seen. The intestinal loop may be ruptured from within by its contents of liquid and air. A bursting rupture of this kind is usually long, extending over a considerable segment.

As a rule, an initial shock follows the application of the force. Not infrequently, however, the patient walks into the hospital and clinically shows no evidence of impending danger. The possibility of rupture of the intestine must be kept in mind when circumscribed blunt force is applied to the abdomen, and the patient should be hospitalized. Within a short while, we have seen a patient die who refused hospitalization. This patient, an elderly man, was kicked in the abdomen one morning by his son-in-law. He was a Pole and understood English with difficulty. Many attempts were made to hospitalize this man, but he refused to enter. The next morning he was brought to the hospital, a spreading peritonitis having developed. He died shortly after an operation was performed. All suspected cases should be hospitalized. There are eleven cases of rupture of the small intestine. Eight of these were operated upon and five died, giving a mortality of 62 per cent. One case that recovered was operated upon within three hours and another within twelve. A perforation of the ileum was found in the third, but a local abscess had formed which was drained.

Petry reports 199 cases with a mortality of 87.5 per cent.; Hertle 138 cases with a mortality of 76.8 per cent.; Wyss thirty-nine cases with a mortality of 33.3 per cent. Just reports eleven cases of rupture of the small intestine from Ranzi's clinic (Innsbruck) with but one death, a mortality of 9.99 per cent. These figures are the best yet given. Seven cases were operated upon within six hours with one death; two cases in from seven to twelve hours with no deaths; two within from thirteen to twenty-four hours with no deaths. All were ruptures of the small intestine without associated injuries.

A provisional diagnosis may be made by the history and usual clinical signs and symptoms. The X-ray assumes a rôle of unusual importance in these cases, for when free air is demonstrated in the peritoneal cavity there is no doubt as to the procedure to be followed. Exploratory laparotomies are

not infrequently performed. If recovery occurs, there are few, if any, sequelæ—these may be post-operative hernia and stenosis of the bowel.

*Rupture of the Kidney.*—In the records of the hospital there are found thirty subcutaneous injuries of the kidneys. In twenty-one cases a diagnosis of an injury of the kidney was made because of the local signs and blood in the urine.

The following cases may be cited:

Case VI.—J. H., white male, age not given, was struck by a train six hours before admission to the hospital. When he entered the hospital the temperature was 98° F., pulse 65 and a tender mass could be palpated in the left flank. He was carefully watched. There was no aggravation of symptoms noted on admission. The hæmaturia decreased rapidly in amount. The patient was discharged three days after admission against advice.

Case VII.—L. S., white male, aged fifty-one years, slipped and fell heavily against a plank, striking his left flank. Within twenty minutes he passed a large quantity of smoky urine. His pulse on admission to the hospital was 56, temperature 97.8°. There were no signs or symptoms of increasing hæmorrhage, although marked dullness was found in the left flank. Red blood-cells were found in the urine for several days, but the patient rapidly recovered.

The following is the record of a patient who sustained a subcutaneous rupture of the kidney. In this instance an operation was deemed advisable.

Case VIII.—P. R., colored girl, thirteen years of age, fell down some cellar stairs, striking the right side of the abdomen. She had difficulty in getting to her feet and ascending the stairs. Severe pain developed in the right flank. When brought to the hospital twelve hours after the accident the temperature was 102.4° F., pulse 120, respirations 28, blood-pressure 95/50. Tenderness was elicited by deep palpation over the right side of the abdomen. The tenderness was, however, most marked over the region of the right kidney posteriorly. The urine consisted almost of pure blood.

At operation the right kidney was exposed. A transverse tear through the middle was found. The tear was closed by suture and a drain placed down to the kidney bed. The patient recovered rapidly after suture of the tear.

Two deaths occurred in the twenty-one cases of contusion of the kidney. In these two cases there were associated injuries. An injury of the kidney was predicated upon the local findings and hæmaturia.

Nine patients were operated upon. Three deaths occurred among the nine—a mortality of 33 per cent. Different operative procedures were employed, such as suture of the tear, nephrectomy, packing and placing of a clamp on the pedicle of the kidney. The last procedure was employed once in the early days of the hospital. The patient had sustained a severe injury with a dislocation of one hip. The patient's condition did not improve. A continuing hæmorrhage from the kidney was suspected and the simplest procedure was employed to control it.

Injuries of the kidney should be treated conservatively unless there are increasing signs of hæmorrhage. Twenty-one out of thirty occurring in this series were so treated, with a mortality of 9 per cent. It has already been mentioned that the concomitant, extensive injuries in two cases were probably the cause of death.

*Rupture of the Bladder.*—Only eleven cases of perforation and rupture

of the bladder have been observed. Among the eleven cases are but two in which the rupture was hydrostatic.

CASE IX.—C. B., colored male, twenty-two years of age, was knocked down while fighting twenty-four hours before admission to the hospital. He had been drinking freely. On admission to the hospital he complained of abdominal pain and passed bloody urine. The temperature was 96° F., the pulse 96, white blood-cells 22,000. The abdomen was greatly distended and marked tenderness, especially to the right of the umbilicus, was noted. Muscular rigidity was also marked. Shifting dullness could also be made out in the lower part of the abdomen. Eighteen hundred cubic centimetres of bloody urine were withdrawn by catheter. An immediate operation was performed. Bloody urine was found in the peritoneal cavity, which was walled off on the right side. A rent six centimetres in length was found in the bladder on the peritoneal side. This extended somewhat into the anterior wall of the bladder. The rent in the bladder wall was sutured and a catheter placed in the space of Retzius for drainage. Patient recovered.

In one case no operation was performed.

CASE X.—A colored male, aged fifty, was brought to the hospital August 25, 1903. He was brought by the police and was said to have been overcome by heat. He had stopped work in the fields four days before. The patient was unable to void and suffered severe abdominal pain. On admission the abdomen was of board-like rigidity. The patient died forty-eight hours after admission. At autopsy an intraperitoneal rupture of the bladder was found.

The cases of extraperitoneal rupture were frequently associated with fractures of the pelvis, and the treatment consisted either of suture of the tear and drainage, or simply drainage of the space of Retzius.

The immediate symptoms of intraperitoneal rupture may vary. Lewis has seen a patient walk into the receiving ward twenty-four hours after having been kicked in the abdomen while in a drinking bout. This patient had no shock and not enough abdominal symptoms to arouse any great suspicion. In another instance the patient was in a railroad wreck. The wreck occurred in the morning at about five o'clock when the patient's bladder was full. He said that when the collision occurred he experienced a slight jolt and was rolled out of his berth. Strangury developed soon and he experienced severe pain in the abdomen. When he was brought to the hospital six hours later, he appeared shocked. Marked rigidity was noted over the lower abdomen and there was marked tenderness. The patient was catheterized and blood-stained urine withdrawn. An immediate operation was performed and a longitudinal rent, extending from the apex to the base of the bladder, was found on the peritoneal surface. Considerable urine was found in the free peritoneal cavity. The rent was sutured, and the patient made an uneventful recovery.

The history is of great importance in making a diagnosis of injury of the bladder. With the modern methods of cystoscopy the diagnosis should be made in a high percentage of cases, but unfortunately these methods do not always give us all the information we desire. Strangury, blood in the urine, lower abdominal pain and rigidity are symptoms of greatest significance. In

some instances an exploratory incision is indicated and should be advised. With refinements in diagnosis, the mortality of subcutaneous and perforating wounds of the abdomen have been gradually, but consistently, reduced.

Early recognition of the probable nature of the lesion and early use of the surgical therapeutic procedure to correct the lesion will be followed by reduction in the mortality. There is an irreducible minimum, however, and this is due to the associated or complicating injuries.

DISCUSSION.—DR. I. RIDGEWAY TRIMBLE remarked that there is one interesting operative procedure, one that is erroneously thought to be life-saving in many cases, that should possibly be mentioned. In subcutaneous injuries in which great hæmorrhage is incurred through rupture of the liver or spleen, not infrequently blood is collected, filtered, and reinfused into the vein of the patient. Thus, Allen reported a patient with a ruptured liver who was reinfused with 800 cubic centimetres of his own blood recovered from the abdominal cavity, and who died fifty-six hours later with complete anuria.

The answer to this unfortunate result may lie in the damage done by the toxins elaborated by a ruptured liver in which autolysis takes place so rapidly. Helwig reported a patient with traumatic pulpefaction of the liver who died eleven days later with jaundice, extensive nephrosis, diffuse hæmorrhages in the serous cavities, with a greatly increased blood nitrogen content, especially the creatinine. The reinfusion of a patient's own blood is often fraught with great danger.

DR. JAMES M. MASON (Birmingham, Alabama) said that he lived in a section of the country where, on account of the large colored population and for other reasons perhaps, they are forced to deal with a large number of these cases. He had been surprised to find there was a mortality in the Johns Hopkins Hospital of around 30 or 35 per cent. in them.

He said the average mortality for that class in the country, as Doctor Lewis said, is between 50 and 60 per cent. In 1923, he attended 127 cases with a mortality of 58.8 per cent. and in 1930 Moyer reported 202 cases in Cincinnati, with 50.8 per cent. In 1931, Billings and Walkling, from Philadelphia, had 156 cases with 55.14 per cent. In 1931, he assembled twenty cases with 55.5 per cent. mortality. In the past year there had been operated on for supposedly penetrating wounds of the abdomen in Hillman Hospital in Birmingham sixty cases with a mortality of 50 per cent.; thirty recovered and thirty died.

Operations were done on eleven with non-penetrating wounds (and they had forty-nine cases for that year) with twenty-eight deaths and a mortality of 57.14 per cent.

These collected cases were not done by any individual surgeon but were from the hospital and visiting and resident staff in the hospitals. As compared with this 50 to 60 per cent. mortality in 1931, B. C. Willard reported sixty-three individual cases with a mortality of 35 per cent. He said that compared very favorably with the mortality which Doctor Lewis had just reported for Johns Hopkins Hospital.

He called attention especially to the influence of hæmorrhage in this 50 per cent. mortality. In the 127 cases that he reported in 1923, he subdivided them into penetrating wounds with extensive visceral injury with minimum hæmorrhage. He found in the parallel cases they had forty-seven cases with large hæmorrhage and forty-one deaths, a mortality of 87.2 per cent. Of the penetrating injuries with small hæmorrhage, forty-seven cases, there were seventeen deaths, a mortality of 36.1 per cent.

As to irreducible mortality he said there is room for improvement to take place in the item of mortality due to hæmorrhage. He considered from what he had read and what he had gathered, particularly from some questionnaires he sent out to 100 of the best offices in the country, that the question of blood replacement is not receiving the important consideration that it should receive for this type of case.

A sociological question comes in here. Most of these penetrating wounds of the

abdomen occur in people in the lowest strata of society and are either the results of brawls and fights among people of that class, or encounters with officers of the law. They are, as a rule, treated not in our more especially organized and better operated hospitals, but in the large charity hospitals of our cities and counties. Blood replacement in these cases to be most successful must be applied not the day after the patient is operated on, nor two or three days later, but immediately, at the time, to receive just the same consideration at the hands of the surgeons as the laparotomy.

He said we all learned about the curability of gunshot wounds in the days of Doctor Fogelbaum. We know that we can prevent peritonitis if we operate promptly and control hæmorrhage. One can reclaim a certain number of cases that would die from hæmorrhage. In that day we did not know about blood replacement and we did not consider it in its proper light.

Blood for transfusion to be of benefit to this class of patients must be obtainable at the same time they come in for the operation, before the laparotomy. The only way that city and charity hospitals can be organized for furnishing this blood is to consider blood as a therapeutic agent of highly specialized type for which there is a definite demand and for which the hospital ought to be prepared to pay, just like it is for elaborate hospital equipment and elaborate X-ray, expensive and elaborate sera and anti-toxin and things like that. Whenever we can establish our charity hospitals and our big public institutions and things of that sort where they recognize that a certain amount of blood ought to be used at a definite time on this particular class of patients, then we can reduce in a large measure this difference between 87½ per cent. mortality where hæmorrhage carries them out, to about 35 per cent. in those cases where they die from complications and things of that sort. He looked forward confidently to the time when all hospital boards will recognize this and supply this blood. In reply to a questionnaire of 101 hospitals in this country, less than 40 per cent. said that they included in their regular expense the question of supplying blood for transfusions for indigent patients.

Dr. Le Grand Guerry (Columbia, S. C.) remarked, in discussing the paper of Doctor Lewis, that some years ago he published in the Annals of Surgery, a paper of "Twenty-seven Cases of Penetrating Gunshot Wounds of the Abdomen with Three Deaths." He was more convinced now than ever before that a number of these cases were saved by taking the necessary time to improve the patient's condition before operating.

Specifically as regards the problem of hæmorrhage, one must remember that in the presence of traumatic shock it takes comparatively little loss of blood to produce a profound circulatory disturbance. He said often they have had this experience; in cases of perforating wounds of the abdomen with hæmorrhage, they have operated on and repaired ten or twelve perforations, practically emptied the abdomen of blood, and completed the operation without finding the source of the hæmorrhage. An irregular tear in a small vessel coupled with a profound drop in blood-pressure permits thrombosis of the vessels, thereby controlling the hæmorrhage before the operation is undertaken. This is one of the main reasons why we never operate with precipitate haste.

We believe it to be a great mistake to take these patients with penetrating, perforating bullet wounds of the abdomen that come in in a condition of profound shock, with or without hæmorrhage, rush them to the operating room and operate immediately. If one does so one is inviting disaster and an excessively high mortality.

He had collaborated on this thought in the text of his paper by pointing out that one has immediate soiling in perforated wounds of the abdomen but not a true peritonitis. It takes time to develop a spreading peritonitis—several hours of time—and this time can be well spent in making the patient a safer surgical risk.

There are those, however, who disregard the above-mentioned principles which he believed to be fundamental not only in relation to bullet wounds of the abdomen, but as applied to the broader field of acute abdominal emergencies. However, when these

principles are so disregarded the proponents will continue to come to the forum of surgical practice in America and talk about 40 per cent. and 50 per cent. mortality.

Dr. William L. Estes (Bethlehem, Pa.) said there is one feature of Doctor Lewis' paper that he would like very much to emphasize, and that is the effect of non-penetrating wounds of the abdomen. He said that most wounds that we have seen have had lacerations and have shown their injury. He had, however, had the experience of seeing quite a number of others, in which nothing visible was evident externally to indicate that there had been any serious injury within the abdomen. Yet because of long shock and weakness and other evidences it was apparent there had been a very serious intra-abdominal injury.

Among the other injuries of the intra-abdominal viscera which he had had occasion to see were lacerations of the greater omentum.

He had distinctly in mind a man who was thrown forward, struck on the edge of a projecting bolt, which made a wound penetrating only the skin and the superficial fascia. That man apparently had such a trifling injury that he was kept at home for a while. Not improving, he was sent to the hospital, evidently in a serious condition of exhaustion and with evidences of some sort of intra-abdominal effusion. He was operated on and it was found that his greater omentum had been torn and that he had been bleeding seriously from the omentum for over twenty-four hours. Doctor Estes said "seriously"—at first it was serious, and then it clotted and finally the clots were being absorbed by the escaping sera.

Another intra-abdominal laceration is a rare condition which he had seen, and that was a laceration of the upper edge of the mesentery. In one case this was torn so that the vessels were opened and the individual was bleeding profusely. It resulted from a precipitation forward by moving machinery, the man striking in spread-eagle fashion on the floor. He was brought in with the tear in the upper part of the mesentery from which he was bleeding profusely.

The fourth rare inury which he had seen was laceration of the jejunum just distal to the duodenojejunal fold, just beyond the membrane, where a part is held firmly and the rest has considerable excursion in the abdomen. These fixed points where an intestine, especially the small intestine, is held and the rest of it is mobile, are vulnerable points. The effect of being thrown forward or being violently propelled forward on the abdomen, with the concussion and sliding pressure, may cause a laceration of the jejunum.

In the case he had in mind he found a transverse laceration, involving almost half of the periphery of the gut.

He was glad to hear that Doctor Lewis' statistics do not indicate that lacerations of the kidney should have operation invariably. He had for many years given up operating on lacerations of the kidney unless there was a very large hæmatoma. Unquestionably the results were far better by expectant treatment.

Dr. M. L. Harris (Chicago, Ill.) said he wished to mention that the injury to the abdomen may not be a severe one in order to cause serious injury to the viscera.

Recently a young man was brought into the hospital. He was strong and healthy, eighteen years of age. He had been riding a motorcycle. He had a collision with a truck. He did not injure the abdomen at all. He came into the hospital and all he complained of were slight bruises on his leg.

Doctor Harris happened to be in the hospital shortly afterward and examined the patient very thoroughly. He seemed perfectly well. There was no tenderness or pain in the abdomen, and the patient complained of none. There was no soreness of any kind. His condition was practically perfect.

The patient was simply put to bed. Within a few hours his condition was absolutely alarming and he died shortly afterward. At the autopsy they found that the

jejunum had been torn completely in two. There was no great hæmorrhage. The patient said when he entered the hospital that he didn't hit the abdomen at all in his accident, and he had no recollection of the abdomen being injured in any way.

Another case showing the effect of hydraulic pressure in a full bladder was that of a young lady, aged eighteen, who had been to a dance and therefore had a full bladder, was riding home late in the morning—or maybe early in the morning—in an automobile which had a collision. She was injured, and brought to the hospital. When he saw the patient she was in extreme collapse with evidence of great hæmorrhage. He transfused her immediately, opened the abdomen which was filled with urine and blood and found that the bladder had been completely torn from the urethra. The bladder was repaired, hæmorrhage stopped, and the patient recovered.

These cases show that slight injuries to the abdomen may occasionally cause severe injury to the viscera.

Dr. Arthur Dean Bevan (Chicago, Ill.) reminded the members of the American Surgical Association that the American Surgical Association had been very intimately associated with the development of this subject. One of the early pieces of surgical research published by Samuel D. Gross was on intestinal wounds. In 1884, he wrote a final paper on that subject.

In 1884, Charles T. Parkes, of Chicago, a member of this Association, did a series of experiments on forty dogs. He anæsthetized them. Then they were prepared aseptically for operation. The abdomen was shot through and the injury done immediately repaired. It is interesting to know that at that time he did this work, it was the first series of experiments on gunshot wounds that had been done on animals with the combined benefit of anæsthesia and asepsis. About half of the dogs recovered. Parkes reported this work in the Chairman's Address of the Surgical Section of the American Medical Association.

Parkes' work was immediately followed, in this country and abroad, by a number of reports of successful operations for penetrating wounds. Bull, in New York, reported one, Hamilton in Washington, Murphy in Chicago each reported successful cases, and it was really the beginning of the modern operative treatment for penetrating wounds of the abdomen.

There were other members of the Association who contributed much to this field of surgery, notably Nicholas Senn with his hydrogen-gas test and bone plates, and John B. Murphy with the Murphy button.

Dr. Frederick C. Herrick (Cleveland, Ohio) remarked that it has been well said: delay in acute appendicitis and intestinal obstruction is fatal. However, delay in some types of abdominal trauma is life saving, if the time is spent in overcoming shock by infusions, morphine, warmth, *etc.*, and preparing the patient for better resistance to the surgical procedure. However, if hæmorrhage is evidenced, the quicker the operation the better. He had many times observed that severe hæmorrhage when seen during its occurrence or soon after is characterized by a progressively slow pulse, even as low as 56 or 58, occurring before an accommodative increased rate is established; a slow pulse is usually the first sign of hæmorrhage.

Rupture or a perforating wound of the liver is not usually followed by dangerous hæmorrhage, and he said they have been treating them by shock measures and tightly strapping the lower right chest. In such cases, a hæmatoma, sometimes of a large size, may form beneath the diaphragm after which it can be aspirated or drained if necessary. As an exception to the rule, he reported a case of a boy of ten to twelve years of age who, falling from a height upon a fence, suffered an almost complete pulpifying of the liver. The patient was not operated on but treated as above. He died from hæmorrhage. Operation would certainly have been of no avail when one saw at autopsy the extent of the damage to the liver.

More amenable to surgery in his experience has been that of serious injuries to the

spleen. Being a more vascular organ, hæmorrhage from it flows along the left colic trough, fills the pelvis, and, following serious trauma of the spleen, forms a definite diagnosis of splenic rupture and indication for a splenectomy. As to the intestine, incomplete lacerations resulting from a jarring fall have especially interested him. A girl of thirteen years sat down heavily on the sidewalk while skating and experienced a little pain in the right iliac fossa but continued her usual activities. Ten days later a mass developed in the right fossa which on exploration proved to be an abscess following rupture of the peritoneal coat of the cæcum and ulceration through of the mucous membranes. Naturally, such occurrences are most common near a fixed point of the small gut which becomes the point of tearing from the trauma. These points are the second portion of the duodenum, the duodenojejunal juncture, the iliocecal juncture; and we must remember that the ascending and descending colon are greatly variable in the length of their mesentery, being practically sessile in one-third of the cases so that at any one of these five points a peritoneal tear may occur by blunt trauma or crushing trauma and later a completion of the injury by rupture through of the mucosa may occur.

To him there has not seemed such great difficulty in diagnosing rupture of the bladder. Take alcoholism with likely a full bladder and muscular relaxation, now add trauma in the shape of a suprapubic blow and rupture is likely. A few hours later muscular rigidity, rising white blood count, abdominal tenderness plus an occasional X-ray for pneumoperitoneum have helped to diagnose these cases. The introduction of air into the bladder seems a good procedure but he had not tried it. He had persistently opposed cystoscopy in these cases, since it had always seemed to him that he would be washing the bladder through into the peritoneal cavity or into the pericystic space.

Bullet wounds of the abdomen have offered some interest, especially with the slow moving bullets from the poor pistols available to many. Many times he had determined that a bullet had not entered the abdomen by the following procedure; with the entrance wound as a centre, eccentric pressure is made in circles around the wound beginning perhaps two to three centimetres away from it. This circle will cross the track if the bullet was reflected in the abdominal wall and tenderness is felt; the next circle, two or three centimetres farther out as these circles are successively made, a bullet track which has passed through the tissue is easily mapped out, showing that the bullet was reflected and not directly penetrated. A most interesting gunshot case was that of a fleshy Italian who sat in a taxi-cab and leaned forward, when he was shot, to grasp his assailant. When seen on the operating table, the bullet wound entered about opposite the navel on the left side, and four other wounds appeared in a direct line down the abdomen to about the middle of the left thigh. The police and friends were certain that there had been five shots. It did not seem possible that they could be all in a straight line. It was easily found that a probe passed from one to two through the fat, and from three to four through the fat, and the final wound entered the thigh. In explanation, as the victim leaned forward to grasp his assailant he wrinkled up the folds of his abdominal wall and the wound penetrated two of these folds, emerging between them. The man's abdomen was not opened and of course a good result followed.

Dr. John H. Gibbon (Philadelphia, Pa.) said the most outstanding feature of this discussion has been the difference in the mortality rates generally reported and that reported by Doctor Guerry.

It recalled to his mind a meeting of this Association in this city a great many years ago when John B. Murphy, of Chicago, reported forty consecutive cases of perforative peritonitis with one death which left us all agape and ashamed of ourselves. Nobody knew what to say.

When Ransohoff of Cincinnati asked Doctor Murphy how many of these cases were more than twenty-four hours old when he operated upon them, Murphy, in closing the discussion said that there wasn't a medical man in Chicago who dared send him a case that was more than twenty-four hours old.

Doctor Gibbon did not think, however, that any such explanation can be applied to this difference in mortality because he thought there was a great deal in what Doctor Guerry had to say.

During the War, in Belgium, at a British clearing station he was struck with the fact that the mortality in major operations was very much higher among the British soldiers than it was among the German prisoners. A great many of the British surgeons used to say, "You cannot kill these Germans."

It didn't take one long to realize why there was this big difference in mortality. It was just this, that the British soldier naturally was operated upon first, was given the precedence when it came to treatment and a prisoner lay abed and was treated for shock and when his turn came he was in better shape and there was a striking difference in the mortality.

But, there is another aspect of this. A great many of them died of peritonitis or of gas gangrene, who never came to the operating table.

In the question of gunshot and stab wounds of the abdomen, one of the most difficult and one of the most important things is the question of hæmorrhage. If you wait with the hæmorrhage cases, if you transfuse them, you are going to lose any number of cases that will not be included when it comes to estimating your operative mortality.

There is not such a great difference in the operative skill of the members of this Association to account for the difference between 10 to 50 per cent. Therefore, it has to be accounted for in some other way.

He thought Doctor Guerry was right when he says if one can just differentiate shock from hæmorrhage, and wait in the case that isn't bleeding the mortality will be very much lower than if one jumps in and operates upon them all at once.

If there is one commentary that can be made, he thought, on surgery, it was the mistake of calling things emergencies that are not emergencies at all.

Dean D. Lewis said he didn't want to give the impression that we get nervous in the presence of gunshot wounds, because we tried to exercise a little judgment, too. But sometimes judgment is a little hard to exercise. When you are waiting and seeing a man getting a little worse all the time and there are progressive signs and symptoms, and you are trying to decide whether this man has shock or hæmorrhage, he was going to take chances on hæmorrhage.

He also found out that the best way to control the symptoms arising from hæmorrhage is to ligate the bleeding point. You can do all the tranfusions and everything possible, if that man is bleeding he is going to keep on bleeding until you ligate.

There is another thing, he thinks Doctor Guerry's patient who was shot in the swamp ought to be very thankful to Providence that he had an open abdomen. He thought prolapse of the intestines had a lot to do with saving him, and feared much more the perforating wounds than the wide open wounds.

Another thing, he thought all statistics showed that the gunshot wounds that are operated on earliest are the ones with the highest percentage of recovery. Whenever he sees a gunshot wound and can operate he operates and does not take any chance on what is going on in the abdomen.

# ACUTE INTESTINAL OBSTRUCTION IN THE NEGRO

## REVIEW OF 347 CASES

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THERE is no subject in surgery which inspires the forceful language and scintillating aphorisms as does a discussion of acute intestinal obstruction. Usually the situation is so dramatic and the need for prompt action is so urgent that the treatment advocated sounds like a "call to arms." No military leader, in exhorting his hosts to go forth to battle, could use more appealing arguments than have been invoked by many gifted members of the profession for immediate surgical intervention in this catastrophe. It would be presumptious and useless to attempt to match the eloquence which has been brought into play. The object of the present paper is to give facts concerning the incidence of the disease in the Negro race, its causes and results, in support of the principles of treatment which never cease to ring in our ears.

Without a previous complete survey the impression has existed that acute obstruction is especially common among colored people, and that the results of treatment are particularly bad. Lacking scientific investigation it was thought that on account of the tendency of the Negro to keloid formation, that adhesions and obstructive bands would be more likely to develop in the peritoneum, following trauma and inflammation. No evidence has been adduced, however, to show that there is anything in the tissues or fluids in Negroes which would make them more susceptible to the growth of peritoneal bands and adhesions.

This study reveals the fact that in the Grady Hospital, Atlanta, acute intestinal obstruction is more than twice as prevalent in colored patients as compared with white patients. During the past ten years, 1923–1932, there were 154 cases of acute obstruction among 50,000 white patients admitted to the hospital, and 347 cases among the same number of Negro patients admitted. Sixty-four white patients and 159 colored patients had strangulated hernia. This difference in the incidence of hernia obviously is due to the more strenuous manual labor done by the black man. The percentage of hernias becoming strangulated is about the same in the two races.

Among 347 Negro patients with acute intestinal obstruction 203 were male and 144 were female, the males predominating by reason of the larger number of strangulated hernias. Otherwise females would predominate, due to operations for pelvic disorders. The death rate in the sexes was remarkably constant, being 30 per cent. in males, 33 per cent. in females, an average mortality of 31 per cent. Strangulated hernia, as is usual, was the most

frequent cause of obstruction, 46 per cent., and furnished the lowest mortality, 19 per cent. The total mortality, excluding hernia, was 41 per cent.

The death rate by years also was fairly constant, being as follows:

| | Cases | Deaths | Mortality Rate |
|---|---|---|---|
| 1923 | 5 | 2 | 40 per cent. |
| 1924 | 35 | 10 | 28 per cent. |
| 1925 | 31 | 10 | 32 per cent. |
| 1926 | 42 | 16 | 38 per cent. |
| 1927 | 23 | 6 | 26 per cent. |
| 1928 | 41 | 14 | 34 per cent. |
| 1929 | 26 | 7 | 27 per cent. |
| 1930 | 48 | 17 | 35 per cent. |
| 1931 | 56 | 15 | 26 per cent. |
| 1932 | 40 | 11 | 27 per cent. |
| Total | 347 | 108 | 31 per cent. |

All fatalities were attributed to the direct results of intestinal obstruction except three deaths from heart disease, three from pneumonia, and one from cerebral hæmorrhage.

The relation of the duration of the obstruction to the result was as follows.

| | Number of Patients | | | |
|---|---|---|---|---|
| | Total | Recovered | Died | Mortality Rate |
| Admitted not more than six hours after obstruction | 31 | 28 | 3 | 10 per cent. |
| Admitted between six and twelve hours after obstruction | 18 | 16 | 2 | 11 per cent. |
| Admitted between twelve and twenty-four hours after obstruction | 91 | 83 | 8 | 8.8 per cent. |
| Admitted second day of obstruction | 74 | 43 | 31 | 42 per cent. |
| Admitted third day of obstruction | 28 | 15 | 13 | 46 per cent. |
| Admitted fourth day of obstruction | 25 | 11 | 14 | 56 per cent. |
| Admitted fifth day of obstruction | 10 | 6 | 4 | 40 per cent. |
| Admitted sixth day of obstruction | 7 | 3 | 4 | 57 per cent. |
| Admitted seventh day of obstruction | 10 | 6 | 4 | 40 per cent. |
| Admitted more than seven days after obstruction | 33 | 18 | 15 | 45 per cent. |

These figures demonstrate graphically the enormous importance of immediate operative treatment. Nearly all these patients were operated upon from one to three hours after admission. While preparations were going forward for the operation, as a rule opportunity was taken for gastric lavage and the administration of saline and glucose by hypodermoclysis. As the majority of patients entered the hospital with unmistakable signs of complete obstruction few enemata were tried before operation. Often too much precious time had already been devoted to this treatment, although the Negro does not believe in the enema. He believes in salts. The Röntgen-ray was not used in diagnosis.

The mortality rate in 140 cases subjected to laparotomy within the first twenty-four hours was 10 per cent. Then the hour of grace was passed, and

the rate arose tremendously, being 52 per cent. in seventy-four patients operated upon during the second twenty-four hours. From this period on the number of hours and days elapsing before operation did not affect the outcome materially, inasmuch as the mortality for all patients admitted after the first day was 46 per cent. No doubt the duration of the illness of some of these Negroes is not stated correctly in every instance, since such people are not always clear in their recollection of time. Nevertheless, there is no question but that they had acute intestinal obstruction, as disclosed by the operative findings, which often also demonstrated how long the condition had been present. Autopsies were done in five cases.

While the treatment of intestinal obstruction by strong cathartic medicines, generally self-administered, is not as detrimental as it is in acute appendicitis, the violent peristalsis induced by huge doses of salts and "black draught" augments the swelling and œdema at the site of obstruction, and probably sometimes causes a partial obstruction to become complete. Almost without exception these patients had taken one or more large purgative doses every day after they became sick.

*Post-operative obstruction.*—Cases of post-operative obstruction, twenty; recovered, nine; died, eleven (two had no second operation). All post-operative obstructions followed operations for acute appendicitis and female pelvic diseases except two for inguinal hernia, one for perforated duodenal ulcer, and one for gunshot wound.

The mortality in patients subjected to operation for port-operative obstruction was 55 per cent. There were twenty such cases, with eleven deaths. In only two or three instances was it possible to show that the obstruction was produced by failure to properly peritonealize all raw surfaces. Formerly this mechanical defect was assigned as a common etiological element. Post-operative obstruction may be caused by rough and careless manipulation of abdominal viscera, and over-exposure, but apparently most cases are due to inflammation and infection which existed prior to the first operation. Perhaps if a second surgeon were called upon to treat the complication he would operate earlier than the surgeon who did the first laparotomy. It is only human for one to be reluctant to admit that it is necessary to reopen the abdomen only a few days after the patient has undergone one serious laparotomy, and the surgeon who performed the original operation is prone to persist in conservative measures too long.

Inhalation anæsthesia was the rule. In fifty-eight patients local anæsthesia was used. Spinal anæsthesia was employed sixty-four times, with fourteen deaths, but the anæsthetic was blamed with none of them. Spinal anæsthesia seems to be losing popularity. Why, is not clear. Few bad results are reported. Certainly it furnishes almost unbelievable abdominal relaxation, but ether still maintains its place as a safe and satisfactory anæsthetic. Avertin was not tried in any of these cases.

Sixteen cases diagnosed as intestinal obstruction recovered without operation; eight died without operation. Five cases were diagnosed as adynamic,

or paralytic ileus. One of these had enterostomy, and recovered; and one had enterostomy, and died. Three died without operation. Hypertonic saline and Ringer's solution were not tried in paralytic ileus in this series. They have proved a valuable asset in private practice.

*Strangulated Hernia*

Number of Cases, 159 (46 Per Cent. of Total)

| | Total | Recovered | Died | Mortality Rate |
|---|---|---|---|---|
| Inguinal | 136 | 115 | 21 | 15 per cent. |
| Femoral | 6 | 3 | 3 | |
| Ventral | 8 | 8 | | |
| Umbilical | 7 | 2 | 5 | |
| Duodenal | 2 | 1 | 1 | |
| Total | | | 30 | 19 per cent. |

Ten cases had resection, three recovered. Five cases had enterostomy, none recovered.

*Operations Causing Obstruction*

| | Number of Cases | Died | Mortality Rate |
|---|---|---|---|
| Appendicectomy | 36 (10 per cent. of total) | 14 | 39 per cent. |
| Salpingo-oöphorectomy | 24 ( 7 per cent. of total) | 8 | 33 per cent. |
| Hysterectomy | 18 ( 5 per cent. of total) | 8 | 44 per cent. |
| Pelvic operation, nature not stated | 11 | 3 | |
| Adhesions following undescribed operation | 11 | 3 | |
| Undiagnosed tumor | 2 | 2 | |
| Cause unknown | 31 | 14 | |
| Total cause unknown | 55 (16 per cent. of total) | | 38 per cent. |
| Perforated peptic ulcer | 6 | 1 | |
| Cholecystectomy | 1 | 0 | |
| Suprapubic cystotomy | 1 | 1 | |
| Cæsarean section | 1 | 1 | |

*Other Causes of Obstruction*

| | Number of Cases | Died | Mortality Rate |
|---|---|---|---|
| Intussusception | 11 (3 per cent. of total) | 7 | 63 per cent. |
| Gunshot wound | 10 | 4 | |
| Cancer of colon | 4 | 3 | |
| Trauma | 3 | 2 | |
| Volvulus | 3 | 2 | |
| Meckel's diverticulum | 2 | 1 | |
| Tuberculous peritonitis | 2 | 1 | |
| Stricture of rectum | 2 (Recovered) | | |
| Mesenteric cyst | 1 (Recovered) | | |
| Retroverted uterus | 1 (Recovered) | | |
| Pneumococcus peritonitis | 1 (Died) | | |

The largest group of cases of obstruction developing months and years after previous laparotomy was in appendicitis, being 10 per cent of the total. During the past ten years there has been a decrease in the number of cases of obstruction following laparotomy for pyosalpingitis, as there has been a decrease in operations for this disease. It is estimated that the number of operations has fallen off 75 per cent. in the past decade. This interesting revolution in surgery in Negro females is ascribed by the gynecologists to milk injections. Either this treatment relieves the patient's symptoms to such an extent that she does not return later for operation, or else the inflammatory lesions are improved so much that operation can be done with less trauma, so that subsequent intestinal obstruction is not so apt to ensue. Sterilized skim-milk, freshly prepared, is the best substance for non-specific foreign-protein therapy, five cubic centimetres being given the first dose, and ten cubic centimetres every week for ten weeks following. Reactions are negligible. No doubt many of the cases of obstruction in this series recorded as due to former pelvic operations, or to adhesions, cause unknown, started with pyosalpingitis. Perhaps some of the other cases marked cause unknown had their genesis in so-called "idiopathic peritonitis," a convenient term.

Four adults had intussusception, two of whom recovered following operation. Two of these cases were caused by lipomata in the wall of the small intestine. Cancer of the colon gives a small incidence in this series. Study of surgical diseases of the digestive system in the two races has shown that peptic ulcer, diseases of the biliary tract, appendicitis and carcinoma occur only one-fourth as often in Negroes as in whites.

*Operative Treatment*

| | Number of Cases | Died | Mortality Rate |
|---|---|---|---|
| Adhesions and bands released | 72 | 17 | 23 per cent. |
| Enterostomy alone (colostomy 2) | 50 | 37 | 74 per cent. |
| Enterostomy and releasing adhesions combined | 13 | 6 | |
| Resections | 22 | 16 | 73 per cent. |
| Lateral anastomosis only | 1 | 0 | |
| Reduction and repair of hernia | 150 | | |
| No operation, or none recorded | 39 | | |

No jejunostomy was performed. Obviously the group of patients treated by enterostomy alone was desperately ill, and the less operative manipulation they had the better. Enterostomy should not be charged with the 74 per cent. mortality, although enterostomy has not afforded the satisfactory results in obstruction which were predicted for it. The procedure is of little avail in paralytic ileus, in which only a short segment of gut can be drained. It seems that the success of the operation depends upon the completeness of the obstruction. The tighter a pyloric ring, the better a gastrojejunostomy drains. Pressure is necessary for drainage.

The treatment of acute intestinal obstruction has varied but slightly during the past ten years, and likewise the results. Before and after opera-

tion adjunct methods, instituted to combat what we understand to be the causes of death in obstruction, have been applied diligently and intelligently. These include lavage, both with the stomach and duodenal tube, and the free administration of fluids, carbohydrates and chlorides, by different means. Without these agents the termination of intestinal obstruction would be even more discouraging than it is. To the monumental work of students and experimenters in demonstrating the value of water, salt and sugar in such conditions, we are profoundly indebted. Even when these accessories do not save life, they prolong the days of many victims of obstruction, and make their suffering more endurable.

In half the cases the path of delayed operation in acute intestinal obstruction leads to the grave, despite the kindly aid which may be handed out along the way. The duration of the obstruction before relieved by operation still remains the principal factor in prognosis. It is a well-nigh hopeless task to educate some classes of patients to seek surgical aid promptly in such cases. Even some of the profession need lessons. In the meantime every precaution should be taken against the occurrence of many forms of obstruction, by insisting upon earlier operative treatment in abdominal lesions, and by thorough, careful surgery, and sometimes less surgery.

Discussion.—Dr. Hubert A. Royster (Raleigh, North Carolina) said that since he resided south of the Mason and Dixon Line, and since for thirty years he had had more or less all the work of a colored hospital of 125 beds, he might be permitted to give his impressions of Doctor Boland's paper.

As a general proposition, the Negro patient does not easily get into surgical shock, but once he is in it is difficult for him to get out. That is to say, he will stand very much more up to a certain point and then after that he slumps. This may be due to the types of diseases treated, or to a poor psychological attitude. The Negro patient rarely has, in Doctor Royster's experience, acute gaseous distention following operations.

Most of the obstructions they have had occurring post-operatively in the hospital, in the matter of four or five days afterward, have been due to bands of adhesions in the pelvis or in the region of the appendix. When Doctor Boland speaks of being able always properly to peritonealize these pelvic cases or even the appendix cases, he probably means only relatively, because most of the pelvic surgery which comes to the operating table on Negro women will give you no chance for flaps or peritoneal covering, as a rule, and a knuckle of gut getting down will very often adhere.

These adhesions are more easily formed and more definitely formed in Negro women because of the very tendency mentioned by Doctor Boland for the formation of fibrinous collections.

Most of the cases, of course, admitted into the hospital after former operations, come in very late. If they get results—and his have been about parallel with Doctor Boland's—it is only because there is a saving grace which prevents these patients from going very much farther.

Many years ago he reported a long series of cases of acute appendicitis in Negroes, less perhaps than that in the white, but they are getting more now.

Dr. William D. Haggard (Nashville, Tenn.) referred to a discussion on the subject of intestinal obstruction before the British Medical Association, when a report was given in which 3,064 cases were collected from London hospitals in the four-year period 1920–1924. Each of the causative factors of obstruction was set forth. The one

causing the largest mortality was intestinal obstruction by gall-stones, which amounted to 50 per cent.

He had had four such cases, three of whom recovered. The unsuccessful case was that of a short, fleshy woman. There was a big gall-bladder full of stones. He removed the gall-bladder. At the conclusion of the operation, the segment of intestine that had the stone popped up into the incision, which obliged him to open it after having superimposed an operation of great magnitude at an inappropriate time. As a consequence, he lost the patient.

The total mortality in this group of 3,064 cases was 26.56 per cent. It was diluted somewhat, of course, by the herniæ which carried the lowest mortality.

The next highest mortality was due to intestinal obstruction from carcinoma, which was 43.5 per cent.

The thing that struck him most in that discussion was a report on intussusception that occurred in the practice of Sir William Taylor, of Dublin, recently deceased, where he said that he had had a personal experience in his own family that was very disastrous. It set him to thinking and to talking. As a consequence, he preached early operation to his students and to all of the medical societies in season and out of season, so that he had educated the entire community to the early detection of intussusception in infants. He had eighty-one cases with only three deaths as a result, which illustrates that it is purely a question of early diagnosis and immediate operation. Intussusception comprised one-fifth of all the cases exclusive of hernia. It made up 40 per cent. of the total number.

He thought, contrary to Doctor Boland, that in post-operative intestinal obstruction the surgeon should be the first man to suspect it and the first to intervene, particularly with enterostomy. If one goes back the third or fourth morning and the patient is vomiting when the anæsthetic is worn off, and there is pain with vomiting, and the patient is given two turpentine enemas and the symptoms are not relieved no matter if the lower bowels are moved, that patient has almost certainly intestinal obstruction and should have an enterostomy at once. It is perfectly surprising how quickly the symptoms will subside and what a delightfully gratifying type of recovery one will have by prompt action in this group of cases. The most dangerous thing that the surgeon meets with is the accidental or sometimes intentional evisceration of the patient. If one can, with the clairvoyant hand find the "bunch" where the obstruction is and pack it off, particularly if it is a whipcord type of band that can be seized with forceps and clipped between, then one is home-free unless by chance it has been so long that one is fearful of leaving the distended coil without an enterostomy.

He cited a case of obstruction in a woman who was six months pregnant and who had previously been operated on by him. His associate did an enterostomy for intestinal obstruction. She was relieved. In two weeks she had another obstruction so severe that in the presence of the six-month pregnant uterus it was necessary to resect six inches of semi-gangrenous intestine, and do a second enterostomy. The patient recovered but with two enterostomies.

The second opening was high in the jejunum and the patient was slowly starving. They devised a very simple obturation of the enterostomy wound. A plain bolus of non-absorbent cotton (with oil in it) placed over the enterostomy wound, was strapped tightly with adhesive plaster. It had the remarkable result of occluding the opening completely and directing the current downward and allowing it to gradually heal without leakage in a short time. Although there was an area as large as a saucer around the high enterostomy of eroded skin, both of these fistulæ were cured quickly by the obturator effect of this ball of oiled cotton strapped over both enterostomy wounds with adhesive plaster.

Dr. Frank K. Boland (Atlanta, Ga.) said he did not think he had ever known of a case where a second surgeon was called in to operate for post-operative obstruction and

probably never will know of one. He suggested that he might operate a little earlier than the man doing the first operation. Of the two cases of duodenal hernia reported as causing obstruction these cases have been previously reported as duodenal hernia by Doctors Cope and Phillips, in December, 1931. But wished to report them now as acute intestinal obstruction. It was only as acute intestinal obstruction that they were recognized. Munyon, in 1906, described the fossa through which these duodenal hernia might take place. One of these on the left side, known as the paraduodenal fossa, or fossa of Landzert, existed in the first case. The second most common place for these hernia to protrude is through the mesentery or parietal fossa. The first case was thirty years of age. Had been sick twelve hours with a certain onset of intense pain and nausea and vomiting. There was the development of abdominal swelling. At operation, the entire intestine was found to have gone through the left paraduodenal fossa behind the peritoneum. He had no bladder symptoms because the tumor mass was telescoping the bladder. In this case we reduced the hernia by pulling out the intestines and twisting the mesentery on its axis and the patient made a recovery. The second case died. Four feet of the intestine was gangrenous and it was resected, enterostomy done.

# ACUTE INTUSSUSCEPTION

By Edwin M. Miller, M.D.
of Chicago, Ill.

In the present paper I shall endeavor to accomplish three things. First, briefly to sketch the pathological and clinical picture in acute intussusception; second, to summarize the results in twenty cases that I have operated upon; and lastly, to point out the advantages of combined conservative and operative treatment.

Since the pioneer work of Nothnagel[1] and Leichtenstern[2] many years ago, when they attempted to produce intussusception in animals by the local application of an electric current or some powerful drug, such as physostigmine, there has accumulated abundant evidence, both experimental and clinical, to show that under normal conditions an intussusception artificially produced tends readily to reduce itself, and that if it is to persist, there must be present either some gross pathological lesion within the bowel wall or within its lumen, or there must prevail some general pathological condition which locally upsets normal peristalsis, and allows one segment of bowel to telescope into another.

It is true that these pathological conditions may exist very high in the gastro-intestinal tract, as in the unusual case of Henke,[3] where the stomach wall was dragged through the entire duodenum by a pedunculated tumor, or as a late complication of gastroenterostomy where several inches or even a few feet of the jejunum may suddenly be sucked upward through a stoma too generous in size. (White and Jankelson.[4]) It is true, also, that most times when a gross lesion can be demonstrated it is found along the terminal portion of the ileum, and usually proves to be either a pedunculated tumor, a lipoma, an inverted Meckel's diverticulum, or an area of local hæmorrhagic infiltration. But it is a universally recognized fact that the great majority of all acute intussusceptions begin at or near the ileo-cecal valve, and that easily 50 per cent. of them occur in infants between the fifth and ninth month of life. This is not difficult to understand when one considers that it is during these early months, and especially during the weaning period, that abrupt changes in diet are apt to be made; that cathartics are too frequently given; that foreign bodies such as pins, buttons, *etc.*, are liable to be swallowed by the creeping child; that anatomically there takes place a rather sudden disproportion between the calibre of the ileum and the large bowel (Power[5]); that the lymphoid tissue, so abundant in this region, may easily become swollen (Perrin and Lindsay[6]); and that the ileum, cæcum, and ascending colon have at this time a relatively long mesentery (Power[7]), permitting a wide range of motion.

In view, therefore, of the possibility that an acute intussusception may

develop at any level in the alimentary tract, may be single or multiple, descending or retrograde in type, and have as its basis a wide range of pathological conditions, it is obvious that the clinical manifestations might vary a good deal, and yet, in the typical case, with its characteristic sudden onset, as out of a clear sky, in an infant previously healthy, the noticeable pallor, the vomiting, the subnormal temperature, the spasmodic attacks of abdominal pain, the passage of blood or blood-tinged mucus, and, finally, the presence of a palpable abdominal tumor, there is a clinical picture so classic that it should rarely fail to be recognized by the doctor who first sees the patient, and to an audience such as this it is so familiar that it scarcely need be mentioned.

The diagnosis having been made, what should be the method of treatment? True it is that spontaneous reduction sometimes takes place, perhaps more often than we suspect; or, if nothing at all is done, spontaneous sloughing of the invaginated bowel might occur, but surely neither of these remote possibilities can hardly be hoped for, much less be expected. Having in mind the rapidly changing pathology, with the imminent danger of complete obstruction, strangulation, and gangrene, one is simply confronted by an emergency, calling for rapid action, and the best combined judgment of the pediatrician and the surgeon. Without question, that procedure is best which, with the least amount of trauma, and the least degree of shock, brings about complete reduction of the invaginated bowel, removes the local exciting cause, if there be one, and minimizes the likelihood of recurrence. I have no doubt that during the early hours, especially in young infants in whom a local tumor is rarely present, and in whom the intussusception is almost invariably an ileo-cecal one, this may be satisfactorily accomplished by conservative means, perhaps sometimes by an enema given by the mother before the doctor is called, perhaps by gentle massage with the hand on the child's abdomen, or by gently distending the colon with warm water or barium under the fluoroscope (Stephens[8]), but the lack of knowledge as to the extent of the pathology, and the uncertainty of the completeness of reduction of the last few inches of damaged bowel, have always seemed to me a great danger, far outweighing whatever advantage either of these conservative methods might possess. I have, therefore, in a series of twenty cases of acute intussusception personally observed at the Children's Memorial, Presbyterian, and Cook County Hospitals of Chicago, always taken the position that no matter how young or how old the patient, how short or how long the duration of symptoms, or how favorable or unfavorable the prognosis, immediate operation was always indicated.

What have been the results? Eleven of these patients have lived, and nine have died, a mortality of 45 per cent. Of the eleven who survived, all but three were under one year of age; the duration of symptoms in only two was over twenty-four hours; reduction was accomplished in all but one case; and in three a lateral anastomosis was performed in order to short-circuit the irreducible tumor or an area of potential obstruction. Of the nine who

died, six were under one year of age; in five the duration was over forty-eight hours; in three, where the invagination could not be reduced, or a potential obstruction existed because of a greatly thickened bowel, death was not avoided by a short circuiting anastomosis; two required resection; one was in too poor condition to allow anything but an ileostomy; and finally, but most significant, two infants, both under one year of age, died even though reduction had been very easy, and the outlook had seemed very favorable.

These results, though they compare pretty well with a series observed by other men of the Presbyterian staff in which the mortality was exactly 50 per cent, and with most larger series, such as that of Braum and Wortmann[9] (Fig. 1) in 1924, in which five German clinics together reported an operative

171 CASES OF ACUTE INTUSSUSCEPTION
TREATED BY PRIMARY OPERATION
Reported by Braun and Wortmann
1923

| Clinic | Infants | | | Children | | | Adults | | |
|---|---|---|---|---|---|---|---|---|---|
| | No. of Cases | Recovery | Death | No. of Cases | Recovery | Death | No. of Cases | Recovery | Death |
| Frommel ( H. Braun) | 10 | 4 | 6 | 6 | 3 | 3 | 16 | 13 | 3 |
| Michaelson (Ringel) | 23 | 5 | 18 | 11 | 8 | 3 | 7 | 4 | 3 |
| Goldschmidt (V. Ziselsberg) | 7 | 1 | 6 | 3 | 2 | 1 | 7 | 4 | 3 |
| Wortmann(W. Braun & A. Neumann) | 17 | 7 | 10 | 16 | 12 | 4 | 10 | 4 | 6 |
| Flesch-Thebesius (Rehn) | 17 | 2 | 15 | 16 | 11 | 5 | 5 | 3 | 2 |
| Total | 74 | 19 | 55 | 52 | 36 | 16 | 45 | 28 | 17 |
| Mortality Rate | | 74.3% | | | 31% | | | 36% | |

FIG. 1.

mortality of 74.5 per cent. in infants, 31 per cent. in children, and 36 per cent. in adults; or that of Perrin and Lindsay[10] (Fig. 2) from London in 1922, in which 400 consecutive acute intussusceptions all immediately operated upon, showed a mortality of 34.8 per cent, yet they appear very unsatisfactory when compared with results from those foreign countries where conservative methods have received a great deal of attention. I refer to Denmark, for instance, where from the old Clinic of Hirschsprung in Copenhagen, a report was made by Kock and Oerum,[11] in 1913, in which 380 cases of acute intussusception showed an operative mortality in infants under one year twice as great as that when conservative methods were used. But, in particular, would I call your attention to Australia, where, chiefly through the influence of one man, Charles Clubbe, the importance of early diagnosis and conservative treatment for many years has literally permeated the medical schools,

the hospitals at Sydney, and has spread far and wide among the lay population. For instance, at the Royal Alexandra Hospital for Children at Sydney, over a period of twenty-five years 834 cases of acute intussusception were observed with an average mortality of 14.5 per cent., and one of Clubbe's assistants, Hipsley,[12] was able to report in 1926 a consecutive series of 100 cases with the almost unbelievable death rate of only 5 per cent.

Let us, for a moment, examine this report. We will observe in particular four things:

*First,* that no case is here recorded in which the diagnosis was not confirmed by palpation of an abdominal tumor.

**RESULTS IN A SERIES OF 400 CONSECUTIVE CASES OF ACUTE INTUSSUSCEPTION**
**Covering a period of 18 years from 1903-1920**
**Reported by Perrin and Lindsay in 1922**
**London Hospital**
**England**

| Year | No. of Cases | Deaths | Mortality |
|---|---|---|---|
| 1903-05 | 74 | 42 | 56.7% |
| 1906-08 | 64 | 26 | 40.6% |
| 1909-11 | 68 | 23 | 33.8% |
| 1912-14 | 81 | 18 | 20.9% |
| 1915-17 | 67 | 12 | 17.9% |
| 1918-20 | 46 | 18 | 39.1% |
| Total | 400 | 139 | 34.8% |
| In this series immediate operative treatment was used without exception. | | | |

FIG. 2.

*Second,* that *sixty-two* of these 100 cases were successfully reduced by conservative methods alone, and in only *thirty-eight,* as a result of failure of conservative methods, operation had to be performed.

*Third,* of the *sixty-two* successfully reduced by conservative means, forty-four had no operation and there were no deaths; and in the *eighteen* (Fig. 3) in whom complete reduction was simply verified through a small incision, there was one death.

*Fourth,* of the *thirty-eight* cases in which failure of conservative methods made operation imperative, there were only four deaths.

Time does not permit a more detailed review of this remarkable report, else we might gather from it several instructive things, giving us a clue, per-

haps, to the secret of this unusual success, which seems to have no parallel in any other land. Yet, we may safely assume that the following factors play a most important rôle:

(1) The teaching of Charles Clubbe has without question exerted an

18 CASES OF ACUTE INTUSSUSCEPTION
Successfully Reduced by Hydrostatic Pressure Alone
But Verified by Operation
P. L. Hipsley

| No. | Date | Age | Duration | Result | Remarks |
|---|---|---|---|---|---|
| 1 | 1918 | 9 months | 12 hours | Recovery | |
| 2 | " | 7 " | 9 " | " | |
| 3 | " | 11 " | 17 " | " | Mass felt per rectum. |
| 4 | 1919 | 9 months | 10 hours | Recovery | |
| 5 | 1920 | 5 months | 22 hours | Recovery | Began 20 cm. above ileo-caecal valve. |
| 6 | " | 6 " | 5 " | " | Oper. 6 hrs. after injec. because persistent vomit. |
| 7 | " | 8 " | 3½ days | " | Bowel greatly thickened at site of intuss. |
| 8 | 1921 | 7 months | 18 hours | Recovery | |
| 9 | " | 5 " | 17 " | " | |
| 10 | " | 9 " | 10 " | " | |
| 11 | 1923 | 5 months | 21 hours | Recovery | |
| 12 | " | 5 " | 33 " | " | Thickened bowel after injection warranted oper. |
| 13 | " | 10 " | 3 days | Death | Pinhole perforation 2.5 cm. above valve. |
| 14 | " | 9 " | 24 hours | Recovery | |
| 15 | 1924 | 5 years | 5 hours | Recovery | Remarkable because of age. Mass easily felt. Diag. appendicitis. |
| 16 | " | 9 months | 4 " | " | 3rd recurrence hence operation. |
| 17 | " | 4 " | 24 " | " | Palpable tumor but no blood. |
| 18 | " | 12 " | 3 " | " | Oper. because abd. had not become distended after injection. |

FIG. 3.

enormous influence on the medical student body in Australia in the past twenty-five or thirty years.

(2) The average doctor in general practice there must of necessity be very alert and capable of recognizing an intussusception in its early stage.

(Witness seventy-three of 100 cases in Hipsley's series observed within twenty-four hours.)

(3) Operative skill has doubtless been very highly developed, so that time has not been wasted, and unnecessary trauma has been avoided.

(4) And most important, there has been perfected over a period of years a conservative method of treatment, which in their hands apparently may be employed with a minimum of uncertainty as to the completeness of reduction. What is the secret of this method? As described by Hipsley it is carried out as follows: Having facilities for operative interference at hand, the child is completely relaxed under anæsthesia, and the abdominal tumor gently palpated, being careful not to confuse it with the lobe of the liver. With the pelvis raised and the buttocks held firmly together, the warm water injection is begun. The flow is rapid, at first, proceeds then slowly and with resistance as the invaginated bowel is being pushed back, and continues more rapidly again as the loops above the intussusception become distended with fluid. This distention, which is generalized and symmetrical, is a most important sign, and together with the passage of gas and yellow fecal material in the return flow, and the disappearance of the tumor which had before been easily felt, gives one a feeling of certainty that reduction has been complete.

Regardless of what your experience or mine has been with intussusception, it is impossible in the light of evidence such as this, particularly from the Australian clinic, to ignore as being unscientific this time-honored and simple method of treatment. To be sure, it cannot always be solely depended upon, nor should it, and to advocate its use generally in this country might be unwise, since it would doubtless often be misused and misinterpreted, yet, if we ever hope to improve the alarming mortality in this, the most common cause of acute intestinal obstruction in early life, we must give this method the attention it deserves. For in young infants, under one year of age, who do not stand operation well, it may be all that is required, and in the older children and adults, in whom a tumor is so often present, if it be used only as a pre-operative measure it may so simplify the procedure that the operation may be completed in a very short time, and a great deal of shock and trauma be avoided.

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DISCUSSION.—DR. WILLIAM E. LADD (Boston, Mass.) said that they had recently been over the cases of intussusception that had occurred in the Children's Hospital of Boston in the last twenty-five years.

Beginning in 1908 there were thirty-two cases in the first five-year period with a high mortality of 59 per cent. That was gradually reduced until in the last period, 1928 to 1932, with ninety cases, the mortality was 14 per cent.

In the last five-year period the mortality is lower regardless of the duration of symptoms. But if the cases are grouped according to twelve-hour periods it will be seen that in sixty cases operated on within thirty-six hours after onset of symptoms there was no mortality, a fact that brings out very clearly the importance of early diagnosis and early operation. The ability to get early diagnosis is dependent on one's ability of educating the general medical practitioner and the pediatrician to send the cases in during the early hours of the disease. The diagnosis is not difficult and if the patients are seen early and thoroughly examined very few mistakes in diagnosis should be made.

As to operative procedures there are one or two points which are important as factors in reducing the mortality. First is the persistence of attempts at reduction. Many times the first part of the reduction of an intussusception goes along very easily and the latter part, where the last few inches have to be reduced, becomes very difficult. Annular pressure on the intussuscipiens and stretching of the receiving ring will often make possible a reduction that at first seemed quite impossible. It is very important to persist in that rather than to proceed with a resection at once. The mortality of resection is extremely high.

The next factor of importance is the liberal use of fluids by enema, both pre- and postoperatively. One should appreciate the fact that the margin of safety, especially on the young infants, which most of these cases are, is pretty narrow. No unnecessary operative procedure should be indulged in, such as removing the appendix or doing any of the procedures which have been recommended to avoid recurrence. In this series of 372 cases there were seven recurrences and no mortality in the recurrences.

He had not been able to effect a reduction by enema and be sure that it was completed.

Not more than two weeks ago he had a child in which a barium enema was given. The X-ray man insisted that the reduction was completed. He did not feel certain about it. When the patient was operated on, they still found about five inches of invaginated bowel.

From resections, they had had very poor results. They had had only two recoveries, one with lateral anastomosis and one with a double-barrelled enterostomy.

DR. ALEXIS V. MOSCHCOWITZ (New York City) referred to Chubb's report that many cases of intussusception were curable by the injection of fluids or insufflation of air into the rectum, saying that when he considered the difficulty, and not so rarely, even the impossibility, of reducing the last few inches of the intersussceptum manually, he had reason to doubt the great frequency of cures by anything less than operative measures. As a result of his experiences, he had arrived at the conclusion that the only way to positively diagnosticate an intussussception is by the sense of sight.

# MECKEL'S DIVERTICULUM IN ACUTE ABDOMINAL EMERGENCIES

By Richard H. Miller, M.D.
AND
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FROM THE CLINIC OF THE MASSACHUSETTS GENERAL HOSPITAL

In a symposium covering the manifold lesions classed under the heading of "The Acute Abdomen," it seems fitting to devote a short while to the scrutiny of those uncommon, but most interesting and bizarre morbid states caused by Meckel's diverticulum. Of recent years numerous enlightening articles on this subject have been written, and one becomes more and more ready to think of this anomaly in the diagnosis of puzzling abdominal lesions for which no more common etiological factor can be found. At the meeting of this Association last year Mason and Graham[1] presented an excellent review mostly devoted to one aspect of the subject, the presence of aberrant gastric mucosa in the diverticulum, with ulceration and hæmorrhage. Ulceration and hæmorrhage constitute an important phase of the pathological occurrences, though by far more common in children than adults. It is our purpose to classify briefly the more important recent literary contributions and add twenty-two cases, one of which has, however, been previously reported. The mode of formation of the Meckel's diverticulum, as an anomalous persistence of the yolkstalk of the embryo, is too well known, and has been too much discussed, to require recapitulation here. (Fig. 1.)

The pathological occurrences which may be encountered are classed by Aschner and Karelitz[2] as follows:

(1) Completely pervious fistula. (2) Sinus at umbilicus. (3) Cyst of umbilicus. (4) Enterocystoma. (5) Fibrous cord from ileum to umbilicus. (6) Meckel's diverticulum.

The same group of conditions, as viewed rather from the clinical standpoint, and seen in children, are listed by Hudson[3] below:

(A) 1, Gastric mucosa without perforation but with hæmorrhage. 2, Gastric mucosa with perforation with or without hæmorrhage. (B) Intussusception. (C) Diverticulitis. (D) Obstruction. (E) Umbilical fistula. (F) Neoplasm. (G) Enterocystoma. (H) Duplex ileum. (I) Mesenteric cyst. (J) Tuberculosis.

The diverticulum may, while symptomatically silent, so to speak, give rise to profuse hæmorrhage, a condition seen most frequently in children, and liable to be confused with intussusception without diverticulum. The hæmorrhage often arises in patients who are apparently perfectly well, and presenting no acute abdominal signs or symptoms. The hæmorrhage usually comes from a peptic ulcer which is in the ileal mucous membrane adjacent to the aberrant gastric mucosa, or not far from it, at the neck of the diverticulum. The ulcer is not in the gastric mucosa itself. On the other hand, in adults, acute lesions are the rule rather than the exception; in our own twenty-two cases in older individuals, only one presented hæmorrhage, and in fact all of them had acute abdominal pain with accompanying signs.

To dispose first of the picture as it appears in children, the extraordinary and interesting tabulation of Hudson[3] is given as an example: Males, 66.6 per cent.; Females, 33.4 per cent.; Mortality, 22.2 per cent.

Gastric mucosa with ulcer and hæmorrhage: without perforation, ten; with perforation, four; intussusception, nine; diverticulitis, six; other obstruction, seven; umbilical fistula, one; duplex ileum, one; incidental, seven; total, forty-five.

It is seen that in children the occurrence of gastric mucosa, with resulting hæmorrhage, fourteen in all, leads all the others in frequency of incidence, though exceeded by the combination of intussusception and "other obstructions," which together number sixteen. Acute inflammation is a low third, with only six cases.

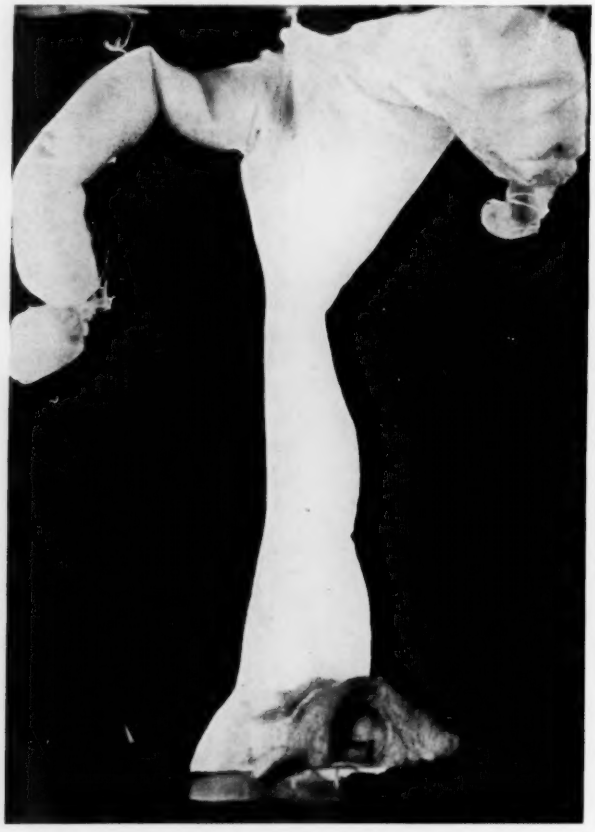

FIG. 1.—Complete Meckel's diverticulum without fistula. This diverticulum, which caused no symptoms, was found at autopsy. (From Pathological Laboratory of Massachusetts General Hospital.)

In adults, on the other hand, other acute abdominal lesions far outnumber the instances of hæmorrhage, and first on the list must be placed intestinal obstruction. Ochsner's[4] classification may here be quoted to advantage: (1) Intestinal obstruction. (2) Diverticulitis. (3) Ulceration. (4) Intussusception.

The mechanics of intestinal obstruction are worked out by Ochsner as follows: (A) With free unattached diverticulum. (1) Knot tied around gut. (2) Dragging and kinking of loop of intestine by distended or cystic diverticulum. (3) Twisting of bowel at origin of diverticulum. (4) Chronic inflammation of diverticulum and intestine, with narrowing of lumen. (5) Acute diverticulitis.

(B) Diverticulum attached to abdominal wall or abdominal viscus. (1) Band con-

stricting or interfering with blood supply. (2) Volvulus of loop of intestine passing under diverticulum and becoming twisted. (3) Volvulus of intestine attached to diverticulum with point of attachment as fixed point of rotation. (4) Strangulation over a tightly drawn diverticulum. (5) Acute diverticulitis. (6) Prolapse of intestine through umbilical fistula.

The different possibilities are thus seen to be numerous, and any one of the above mechanical accidents may occur in conjunction with an acute diverticulitis which, in turn, may lead to perforation of the diverticulum itself.

Mason and Graham[1] collected, including their own, thirty-three cases of bleeding from ulcer of Meckel's diverticulum, with a mortality of 33.3 per cent. Of this group of cases fourteen also perforated, with a mortality of 42.8 per cent., whereas thirteen which did not perforate, and all of which were operated on, had no mortality whatever. There was one case of acute diverticulitis.

Jackson[5] reported nine cases in which hæmorrhage from the diverticulum was the leading feature; these were all infants or children, and all recovered. Aschner and Karelitz[2] collected thirty-three cases, to which Cobb[6] added four more, including one of his own—a total of thirty-seven—presenting hæmorrhage in thirty, or 81 per cent.; perforation or penetration in twenty-one, or 56 per cent.

In contrast to these features, Harbin's[7] first thirteen cases were as follows: Casual (no symptoms), five; acute and subacute inflammation, five; acute obstruction, one; volvulus, one; gangrene, one.

In a second report Harbin[8] collected nineteen cases, five of which required more than one operation; in three of them the diverticulum was overlooked the first time, and, in two, post-operative obstruction occurred.

Lower[9] collected fifty-two cases of intussusception caused by the diverticulum, adding two of his own, making a total of fifty-four; in these, recurrent attacks of obstruction were the rule, and hæmorrhage not so common. Wolfson and Kaufman[10] have added four cases of acute diverticulitis, three of which perforated.

The leading groups of cases, from the recent literature, and mentioned above, may be abstracted as follows:

TABLE I

*201 Cases of Meckel's Diverticulum*

| | |
|---|---|
| Ulcers, with hæmorrhage or perforation, or both | 93 |
| Intussusception | 63 |
| Other intestinal obstruction | 26 |
| Acute inflammation | 10 |
| Miscellaneous | 9 |
| | 201 |

Our own cases are tabulated as follows: AUTHORS' CASES: Total, forty (one previously reported, R. H. Sweet[11]); causing acute symptoms, twenty-two; incidental, eighteen. Ages, eleven to twenty, seven; over twenty, fifteen.

The pathological findings were as follows: (1) Obstruction; (A) bands or adhesions, nine; same with acute inflammation, two; (B) volvulus, three; same with acute inflammation, two; (C) adjacent mesenteric defect, with acute inflammation, one; with abscess, one; (D) intussusception, one; (2) acute diverticulitis (simple), three.

The pre-operative diagnoses follow. The two cases classed as "femoral hernia" were instances in which an inflamed diverticulum was found in the sac of a femoral hernia (the so-called Littré's hernia).

*Pre-operative Diagnosis.*—Intestinal obstruction (not specified), fifteen; acute appendicitis, five; femoral hernia, two; perforated ulcer, one. Only one had blood by rectum.

The mortality was as follows: recovered, sixteen; died, peritonitis, five; shock (?), one; mortality, 37.5 per cent.

The pathological reports, given below, reveal only one case, in the seventeen in which a record is made, of the finding of gastric mucosa. Some of these date back a good many years, and it is possible that proper search was not made for the anomaly.

*Pathological Report.*—Gastric mucosa, one; ileal mucosa, sixteen; not recorded, five; acute infections, seven; circulatory gangrene, ten; no report, five.

Case Reports.—Case I.—Male, aged seventeen. Three acute abdominal attacks of which the last one was diagnosed acute obstruction. Some blood passed by rectum on giving enema. Operation revealed intussusception which was reduced with difficulty. Perforation found, and eighteen inches of intestine resected. Slow but eventual recovery.

Case II.—Male, aged fifty-seven. One attack diagnosed acute obstruction. Operation revealed the obstruction caused by a kink around a diverticulum which was five centimetres long. Three inches of intestine resected and ileostomy done. Patient died following secondary closure.

Case III.—Female, aged twenty-three. One attack diagnosed acute appendicitis. Operation revealed a diverticulum, acutely inflamed, with its tip adherent to the mesentery of the ileum and causing constriction of one loop of ileum. The diverticulum was excised, and the patient's convalescence was uneventful.

Case IV.—Male, aged twenty-four. One attack, diagnosed acute obstruction. Operation revealed obstruction caused by a thick band extending from the tip of an inflamed diverticulum and adherent to the root of the mesentery, strangulating beneath it a loop of intestine. The band was severed and the diverticulum removed. The convalescence was uneventful.

Case V.—Male, aged twenty-six. One attack, diagnosed acute appendicitis. There was an abdominal opening in the mesentery of the small intestine through which opening a loop of terminal ileum had herniated, and this loop was held *in situ* by a gangrenous ruptured diverticulum which was adherent in the left upper quadrant of the abdomen. An abscess had formed. The diverticulum was freed and removed, and the hernia reduced. The patient died of peritonitis.

Case VI.—Male, aged forty-five. Patient complained of a lump in the right groin which had followed exertion one month previously. This mass was not tender, but was irreducible. The pre-operative diagnosis was incarcerated femoral hernia. At operation the sac was found to contain adherent bowel, which was an incarcerated diverticulum. Removal was followed by uneventful recovery.

Case VII.—Male, aged seventy-two. (This case reported by Sweet.[31]) The patient complained of a recently developed mass in the right groin; the mass was painful but caused no vomiting or generalized abdominal pain. Examination showed a hard, tender irreducible mass, diagnosed incarcerated femoral hernia. Operation revealed an inflamed adherent diverticulum, twelve centimetres long, in the hernial sac. The diverticulum was removed and hernia repaired. Convalescence was uneventful.

Case VIII.—Male, aged eleven. One attack of acute abdominal pain, diagnosed as acute appendicitis. Operation revealed a hernia of six inches of ileum through a defect in the mesentery of the small intestine, and the herniated bowel was prevented from reducing itself by an acutely inflamed Meckel's diverticulum which was adherent to the posterior abdominal wall. The hernia was reduced, the diverticulum and the appendix were removed. Uneventful recovery took place.

Case IX.—Male, aged fourteen. There was a history of several attacks of acute abdominal pain. On admission to the hospital there were pain, vomiting, slight distension, active peristalsis, slight tenderness and no spasm; the diagnosis was acute intestinal obstruction. Operation revealed a volvulus of a loop of ileum around an acutely inflamed diverticulum which was adherent over the cæcum. The volvulus was relieved, and the diverticulum and the appendix were removed. Convalescence was uneventful.

CASE X.—Male, aged twenty-eight. Attack of extremely severe abdominal pain of two and one-half hours' duration. No previous gastro-intestinal disorder. The abdomen presented extreme tenderness and spasm. Diagnosis—perforated peptic ulcer. Operation revealed a volvulus of a loop of ileum at a point where a Meckel's diverticulum was adherent to the mesentery of the terminal ileum. The loop was freed and the diverticulum was removed. Recovery was uneventful.

CASE XI.—Male, aged fifteen. The appendix had been previously removed. The history was one of six days of increasing abdominal cramps, with vomiting and obstipation. Diagnosis was acute intestinal obstruction. Operation revealed a volvulus of a loop of ileum twisted one and one-half times, due to an inflamed Meckel's diverticulum adherent to the old scar. The volvulus was freed and the diverticulum removed. Convalescence was uneventful.

CASE XII.—Male, aged thirty-two. History of abdominal pain at intervals for six years. The present attack had continued about twenty-four hours, and was thought to be due to a mild acute appendicitis. Operation revealed an acutely inflamed diverticu-

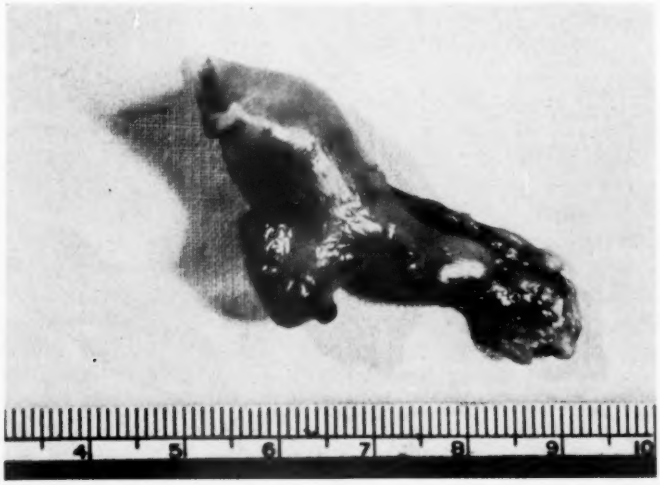

FIG. 2.—A Meckel's diverticulum, subacutely inflamed, probably causing symptoms, found at exploratory laparotomy. Patient a male of thirty-five.

lum, five centimetres in length, arising from the side of the terminal ileum. This was removed, and the patient's recovery was uninterrupted.

CASE XIII.—Male, aged twenty. One attack of acute abdominal pain of three days' duration, with vomiting, and no bowel movements, even with enemas. Had been given much morphine. Examination showed the abdomen rigid and distended. The diagnosis was intestinal obstruction. Operation revealed a black coil of small intestine, twisted on itself, with a gangrenous Meckel's diverticulum at its summit. The volvulus was untwisted, the diverticulum removed, and drainage established. The patient died of general peritonitis.

CASE XIV.—Male, aged thirty. History of two attacks of which the recent one had lasted two days. The general picture warranted a diagnosis of intestinal obstruction, though it was not recorded. Operation revealed a diverticulum adherent to the abdominal wall in the region of the internal inguinal ring, also a constricting band, causing obstruction. The diverticulum and appendix were removed, and the band severed. The patient died, cause of death not determined. (Fig. 2.)

CASE XV.—Female, aged forty-four. One attack of acute abdominal pain, chiefly in the left lower quadrant, with symptoms and signs leading to a pre-operative diagnosis of intestinal obstruction. Operation revealed an obstruction due to a diverticulum

adherent in the region of the left iliac vessels. Removal of the diverticulum relieved the obstruction and the patient had an uneventful recovery.

CASE XVI.—Male, aged forty-three. History of acute attack of four days' duration, typical of intestinal obstruction. Precise diagnosis not made before operation, which failed to reveal the cause of the trouble. Ileostomy was done but the patient died of peritonitis. Autopsy showed the obstruction due to an adherent Meckel's diverticulum.

CASE XVII.—Male, aged twenty-three. History of acute attack of four days' duration, ending in complete obstruction and fecal vomiting. The diagnosis was intestinal obstruction, and operation showed it to be due to a Meckel's diverticulum adherent by a strong band to the anterior abdominal wall. The diverticulum was removed and the band freed, resulting in complete recovery.

CASE XVIII.—Male, aged twenty-six. Acute attack of abdominal pain of four days' duration. Temperature 103°. Pulse 160. Abdomen distended, tender, and tympanitic. Diagnosis not recorded. Operation revealed a twisted gangrenous Meckel's diverticulum springing from the lower ileum and adherent to the under surface of the umbilicus. In the course of removing this it ruptured. The patient died of general peritonitis.

CASE XIX.—Male, aged eleven. Acute abdominal attack of one day's duration. Diagnosis not recorded. Operation showed the small intestine to be obstructed by an adherent Meckel's diverticulum. Following removal, convalescence was uneventful.

CASE XX.—Male, aged thirty. There was a history of recurrent attacks of acute abdominal pain for a period of several years. No positive diagnosis was made. Exploratory operation revealed an acutely inflamed Meckel's diverticulum and what appeared grossly like an equally inflamed appendix. The pathological report was "acute diverticulitis and acute peri-appendicitis." The patient's convalescence was very protracted and stormy, due to a hæmorrhage from the meso-appendix.

CASE XXI.—Male, aged twenty-six. The appendix had been removed six years before, and this operation was said to have been followed by peritonitis and a pelvic abscess. The present attack was of acute pain, and vomiting of fecal material. The pre-operative diagnosis was acute intestinal obstruction. Operation revealed a black and gangrenous Meckel's diverticulum running from the ileum down to the right side of the pelvis, and under this a loop of small intestine was caught and obstructed. The diverticulum was removed, but ruptured in doing so, and drainage was established. The patient recovered after a rather stormy convalescence.

CASE XXII.—Female, aged forty. Ten days after a vaginal hysterectomy she developed signs suggestive of intestinal obstruction, but she was carefully watched for two days before operation seemed imperative. The diagnosis was acute obstruction. Operation revealed a Meckel's diverticulum caught down and adherent to the recent wound at the upper end of the vagina. The diverticulum was freed up and removed, and the patient's convalescence was uneventful.

*Conclusions.*—A review of the literature, and a further analysis of the above cases, must impress the surgeon with the necessity of always bearing in mind the possibility that Meckel's diverticulum, which occurs in about 2 per cent. of all human beings, and which is so protean in its manifestations, may be the etiological factor in any acute abdominal emergency. It should always be thought of in the cases which are difficult of diagnosis. Search should always be made for it, when feasible, in an exploratory laparotomy and particularly at the time of removal of the so-called chronic appendix.

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DISCUSSION.—DR. ALFRED BROWN (Omaha, Neb.) reported a pathological condition of Meckel's diverticulum which illustrated a principle emphasized several times that morning. It is, if the injured portion of the intestine is brought outside the peritoneal cavity and then kept outside the peritoneal cavity, a good deal of surgical manipulation can be done away with. This allows the surgeon to follow the principle that the least amount of surgery done in these cases, the better for the welfare of the patient. The patient was twelve years of age. He entered the hospital with all the symptoms of what was considered an attack of acute appendicitis. On making an incision, there was apparently not enough trouble found in the appendix to account for the symptoms. Further search revealed a band leading to the umbilicus, and when this band was divided a completely gangrenous Meckel's diverticulum was brought out of the abdominal wound. This was rotated on its long axis, there being about one and a half turns at its base. An interesting point in this case is, that contrary to the teaching of most of the anatomical text-

books the statement made by Milesé* holds true that Meckel's diverticulum has a blood supply of its own which runs to the tip through a mesentery which passes in front of the ileum.

In this case, there was a distinct line of demarcation between the normal gut of the small intestine and the gangrenous portion of the Meckel's diverticulum. The boy was in very bad condition. There was a certain amount of peritonitis. There was considerable serosanguineous fluid in the peritoneal cavity. He had a count of 29,000 white cells and 94 per cent. of polymorphonuclear leukocytes. Instead of trying to do a resection a clamp was placed at the base of the Meckel's diverticulum, and a dressing was placed around it. The boy was put back to bed and the diverticulum allowed to slough off. This it did in five days. Although the convalescence was rather stormy, he made a good recovery. The fecal fistula left after the operative procedure closed gradually and he was discharged from the hospital in fifty-nine days.

Dr. William B. Coley (New York City) remarked that in 1920 he reported a case of strangulated hernia from Meckel's diverticulum before the Southern Surgical Association, together with a review of seventeen additional cases collected from the literature. The rarity of the condition is shown by the fact that Balfour, in a review of 10,000 successive operations performed at The Mayo Clinic from 1907 to 1910, found only fifteen cases of Meckel's diverticulum; only five had given rise to symptoms, and only one of these was operated upon for acute intestinal obstruction due to adhesions about an inflamed diverticulum. There was no case of strangulation. His own case was a man, aged twenty-six years, who was admitted to the Mary McClellan Hospital, Cambridge, New York, June 6, 1920, at 7 P.M. He was a farmer who had always enjoyed excellent health. On the day of his admission he had eaten a good breakfast. Shortly afterwards he felt slight nausea and discomfort in the epigastrium. One hour later he began to have severe paroxysmal pains low down in the abdomen, which he characterized as "doubling-up" pains. These recurred at intervals of a few minutes. He vomited for the first time one and a half hours after his breakfast, and twice in addition before the operation.

On admission he showed slight tenderness in the right iliac fossa and region of McBurney's point, but no rigidity. Rectal examination negative; no mass palpable in any portion of the abdomen; no localized distension. Temperature, 98.6°; pulse, 72. Blood test: whites, 12,400; polymorphonuclears, 90 per cent. While he was unable to make a diagnosis he did not regard the condition as one of acute appendicitis. He felt that the steadily increasing paroxysmal pains rendered an exploration imperative. An immediate operation was performed. The appendix was found to be normal. A careful search revealed a loop of small intestine, about one and one-half to two feet in length, greatly distended and dark in color but not gangrenous, located in the bottom of the abdomen, somewhat more to the right side than to the left, a little above the pelvis. The loop of bowel was firmly attached to the pelvis below and connected with the small intestine above. The constriction was so tight that it was absolutely impossible to withdraw or to free the strangulated loop. It soon became apparent that they were dealing with a Meckel's diverticulum, nearly of the same calibre as the normal small intestine, coming off at a right angle from the lower portion of the ileum, about two feet from the ileocecal valve and extending downward to the root of the mesentery. The diverticulum was removed and after a short time the dark-colored bowel regained its normal color. The patient made an uneventful recovery.

Dr. James Morley Hitzrot (New York City) related the case of a little girl of twelve who came to the hospital with an obscure intestinal bleeding. She had an onset of pain in the right side. Her temperature was 100°, leucocyte count 10,000 with nothing particularly noticeable about it. In examining her stool, ova of the ascaris were

* Milesé, Choyce: System of Surgery, vol. ii, p. 442.

found. She was treated for ascarides which removed the worm and her bleeding stopped. Therefore, he thought the bleeding was due to the ascaris. She came back on two occasions. She had acute abdominal pain, usually following some indiscretion in her diet. She was sent by her physician with the diagnosis of appendicitis. He went over her carefully. Her tenderness was at the umbilicus and above it and suggested some form of gastroenteritis which with a little diarrhœa made that diagnosis seem likely. She finally came to the hospital as an acute appendicitis case. He found an acutely inflamed diverticulum about twenty-two inches from the valve.

The curious fact in her case, which they found on asking her afterwards, was that during the period she was under observation, which was about a year and a half after the ascaris experience, she had not mentioned bleeding as a major symptom, but on close questioning she stated she had had bleeding from the time she was about nine years old up to the time that she was operated upon. A point which Doctor Miller emphasized in these obscure forms of bleeding from the intestine in children as suggested by Meckel's diverticulum.

Doctor Hitzrot said he failed then to recognize that fact, although he learned it later. That is a rather important point in helping to a diagnosis.

Dr. Fred B. Lund (Boston, Mass.) said, as to Meckel's diverticulum, that since a certain experience, he had made it a rule to look for it in all cases of appendicitis where the appendix does not seem to be much diseased. He was called into consultation on account of obstructions by adhesion. He found the patient with a slight temperature and enormous distention. The intestines were red and inflamed. He did not dare to do anything but an enterostomy. A week later, the distention having gone down, he explored to find what the cause of the obstruction was. It was a gangrenous Meckel's diverticulum lying in the bottom of the pelvis, which was the trouble all the time. He removed it, but it was too late, and the patient died.

He often finds a Meckel's diverticulum in operating for other troubles in the abdomen. He usually lets it alone. Before operating if there is any history of hæmorrhage, it would be wise to remove it as soon as it is found although he had never done it.

Dr. Charles G. Mixter (Boston, Mass.) recently had an opportunity to analyze a series of seventy-six instances of Meckel's diverticula. Forty-six of these were seen at the Children's Hospital of Boston, forty-five of which were reported by Hudson; eight from the Beth Israel Hospital as well as the twenty-two that Doctor Miller was good enough to let him review, perhaps prematurely. Of these, sixty-three had acute abdominal symptoms. If these sixty-three cases are divided into two general groups, in the one group putting the infants and children, in the other group the adults and the older-aged patients, one finds that the pathology is very definitely different in the two series of cases. In the Children's Hospital series, reported by Hudson, the preponderant symptom is hæmorrhage. Intussusception occurs frequently but the cases of hæmorrhage are the salient ones, and intestinal obstruction from other causes is rare. On the other hand, in the older-age group the cases of outstanding hæmorrhage from ulceration caused by gastric heterotopia in the sac are rare, whereas the cases of intestinal obstruction predominate.

If the fourteen cases represented with hæmorrhage be combined with those with Mason's thirty-three collected cases, they can be divided into two groups: first, those cases in which hæmorrhage alone has been the feature. It may have been extremely massive but the mortality in that group is 5 per cent. When intestinal obstruction is associated with the hæmorrhage, a sudden rise in mortality to 50 per cent. is encountered.

# WANDERING SPLEEN WITH TORSION OF THE PEDICLE

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of Louisville, Ky.

Under certain conditions which permit loosening of its attachments the spleen descends from its normal position in the left hypochondrium into the abdomen. When the elongation of its pedicle is such as to allow its appearance in other than the left upper abdominal quadrant it is designated as a wandering or floating spleen. The factors concerned in its abnormal mobility are both congenital and acquired. The former are chiefly two, the length of the splenic pedicle and the conformation of the abdominal cavity. In the latter the area between the intercostochondral arches is materially diminished while the paravertebral niches are definitely shallower, as a result of which intra-abdominal pressure is diverted from its normal direction and prolapse occurs. The acquired factors may be grouped under two headings, increased weight of the spleen and the conditions which bring about relaxation of the abdominal wall and of the ligaments which support the abdominal viscera. While either of these factors may be the determining one in a given case, in a majority of instances two or more will be found to have contributed to the splenoptosis. When the mobility of the spleen attains an extent that will allow axial rotation on its pedicle, torsion of varying degree may result with more or less disastrous consequences. Two such instances have come under my observation.

Case I.—A white woman, aged thirty-four, robust and well developed, came under my care in 1912. She gave no history of previous illness or of symptoms related to the spleen. She had borne one child and at the time of the then present illness was three and one-half months pregnant. While engaged in household duties she was seized with sudden, abdominal colic attended with nausea and vomiting. She was admitted to the hospital forty-eight hours after the onset of the attack, at which time she had a temperature of 101½° and pulse of 110. The right half of the abdomen was rigid and tender and presented a tumor which extended from the pelvic brim to a point above and to the right of the umbilicus. Pelvic examination revealed a pregnant uterus with the tumor lying in contact with its right upper surface. The urine was negative. The blood count showed a leucocytosis of 12,000 with an increase in the polymorphonuclear cells. Operation revealed the tumor to be the spleen, approximately two and one-half times the normal size. It was not adherent and was easily delivered through the incision. The pedicle showed two complete turns, the tail of the pancreas being incorporated in its proximal end. This was disengaged by detorsion, the pedicle ligated and the spleen removed. The latter showed intense congestion but no thrombosis of the vessels. The patient made a good recovery and underwent normal delivery five and one-half months later.

Case II.—White woman, aged forty-six, thin and ptotic in physique, came under observation in 1919. She had borne four children and had passed the menopause seven years before. She gave a history of digestive disturbance extending over a period of years but had had no colic until the onset of her present illness. The latter was charac-

terized by severe cramps in the abdomen lasting three days, accompanied by nausea, vomiting and fever. Following the subsidence of the cramps the right lower quadrant became exquisitely sensitive and a mass became apparent. At the time of her admission to the hospital, two weeks after the onset of her illness, she presented a fixed mass in the right lower quadrant which was extremely sensitive. Pelvic examination showed an atrophic uterus; tubes and ovaries not palpable. Urine showed a trace of albumin, some granular casts, otherwise negative. Blood showed hæmoglobin of 80; red cells, 4,000,000; white cells, 10,000. Operation revealed a tumor completely covered by omental and intestinal adhesions except at its upper pole. Upon separation of adherent omentum and intestine the tumor proved to be the spleen. The pedicle showed two complete turns and presented thrombosis of both artery and vein. The surface of the spleen showed a number of spontaneous ruptures from which no bleeding had taken place, indicating that they had occurred subsequent to the occlusion of the arterial blood supply by torsion. Capillary oozing from raw surface on adhered organs controlled by ligatures and hot packs, pedicle ligated and spleen removed. Recovery was delayed by a right femoral thrombophlebitis, the patient being discharged from hospital four weeks after operation. This spleen weighed 370 grams; was of dark, reddish-gray color, smooth, with a few fine, fibrous tags attached over its diaphragmatic surface. The organ consisted of two almost completely separated lobes with a fissure between, extending from the hilus over the anterosuperior surface down to the inferior margin. On the diaphragmatic surface there was a transverse fracture near the lower pole, forty-seven centimetres long, two to three millimetres wide and about 5 millimetres deep. A crescentic fracture was found near the upper pole posteriorly, thirty millimetres long, six millimetres wide and seven millimetres deep. In the parietal surface was an L-shaped longitudinal fracture near the hilus, sixty-three millimetres long with an arm twelve millimetres long, four millimetres wide and six millimetres deep. In the diaphragmatic surface near the anterior border was a fracture thirty-three millimetres long, three millimetres wide and eight millimetres deep extending longitudinally from the end of a cleft. On section the pulp was very dark reddish-brown, almost black, except near the capsule, where it was reddish-gray. No Malpighian corpuscles were apparent. The vessels were thrombosed.

In a review of the literature we have been able to find ninety-five reports of wandering spleen with torsion of the pedicle, in addition to the two cases herewith recorded. No case has been included in which torsion of the pedicle is not specifically mentioned as a causative factor in the production of symptoms and pathology. The pertinent facts, as revealed by an analysis of these reports, are shown in the following tables:

AGE AND SEX

| Age | Female | Male | Total |
|---|---|---|---|
| 1–10 | 0 | 1 (age 6) | 1 |
| 11–20 | 9 | 2 | 11 |
| 21–30 | 28 | 1 | 29 |
| 31–40 | 26 | 1 | 27 |
| 41–50 | 11 | | 11 |
| 51–60 | 3 | | 3 |
| 61–70 | 1 | | 1 |
| 71–80 | 1 | | 1 |
| Not stated | 9 | | 9 |
| Age and sex not stated | | | 2 |
| Totals | 88 | 5 | 95 |

It is interesting to note that twelve, or 14.3 per cent., were observed before the age of twenty, while fifty-six, or 66.7 per cent., occurred between the ages of twenty and forty, leaving but 16, or 19 per cent. for the years of normal physical decline. Of the ninety-three cases in which the sex was stated but five were noted in males. In the group occurring before the age of twenty it would seem that congenital factors played the predominant etiological part since the conditions which give rise to abdominal distension and atony were absent. In the group of twenty-nine occurring between the

PHYSICAL DEVELOPMENT

| | |
|---|---|
| Normal | 11 |
| Obese, robust or muscular | 9 |
| Spare, thin or delicate | 12 |
| Asthenic or ptotic | 13 |
| Not stated | 50 |
| Total | 95 |

MALARIA

| History of | Splenic Enlargement Before Torsion | Size of Spleen When Removed |
|---|---|---|
| 1 | 1 | 2190 gms. |
| 1 | | |
| 1, no history, prasites found. | | 1350 gms. |
| 1 | | |
| 1 | 13 years | 4200 gms. |
| 1 | 1½ years | 1200 gms. |
| 1 | | 1520 gms. |
| 1 | | |
| 1 | 3 years | 37x22x12 cm. |
| 1 | | 1750 gms. |
| 1 | 1 | 400 gms. |
| 1 | 1 | 5 to 6 times normal |
| 1 | 1 | 2100 gms. |
| 1 | 1 | 3500 gms. |
| 1 | 1 | 800 gms. |
| 1 | 1 | 3000 gms. |
| 1 | 2 years | 1000 gms. |
| 1 | 3 years | 1600 gms. |
| 1 | 2 years | 2125 gms. |
| 1 | 7 years | 750 gms. |
| 1 | 1 | 1635 gms. |
| 1 | | 25x18 cm. |
| 1 | | |
| 1 | 3 years | 1870 gms. |
| 1 | | |
| 1 | 1 | 710 gms. |
| 1 | | 1520 gms. |
| 1 | | 1540 gms. |
| 1 | 17 years | 840 gms. |
| Total, 29 | 18 | |

ages of twenty-one and thirty, constituting 34.5 per cent., at a time of life when physical development is presumably at its highest, it is reasonable to presume that congenital causes could not be entirely excluded in the determination of etiology.

Of the forty-five cases in which physical development was registered but twenty-five were recorded as belonging to the types in which ectopia is commonly found, the remaining showing normal or robust physique. While the spleen may participate in a general visceroptosis it is frequently the one organ which remains in its normal position and again it is often the one organ showing ptosis when the remainder evince no such tendency.

A history of malaria was given by twenty-eight patients and the parasites found in a twenty-ninth who gave no such history. In eighteen there was a known presence of splenic enlargement or "ague cake" before the advent of torsion. Even in the presence of such an incidence it is evident that the weight of the spleen is not the prime factor in its displacement and torsion since in no history is there mention made of tumor or splenomegaly of other origin in which prolapse and torsion were complicating features. The splenic enlargement common to Banti's and Gaucher's disease, leukæmia and hemolytic jaundice is usually unassociated with prolapse even in the absence of anchoring adhesions. Of the twenty-one cases in which the weight of the

PREGNANCY AND THE PUERPERIUM

*88 Females*

| Parous | Cases | Torsion During Pregnancy or the Puerperium | |
|---|---|---|---|
| P | 3 | 1 Pregnant 4 mos. Splenectomy. | Recovery |
| P | 7 | 1 Pregnant 5 mos. Splenectomy. | Died |
| 1 P | 8 | 1 Pregnant 2 mos. Splenectomy. | Recovery |
| 2 P | 6 | 1 Pregnant 4 mos. Splenectomy. | Recovery |
| 3 P | 5 | 1 Pregnant 5 mos. Splenectomy. | Died |
| 4 P | 4 | 1 Pregnant 3 mos. Abortion during attack. Splenectomy. | Recovery |
| 5 P | 6 | 1 Pregnant 5 mos. Abortion 24 hrs. after op. Splenectomy. | Died |
| 6 P | 4 | 1 Pregnant 4 mos. Splenectomy. | Recovery |
| 7 P | 3 | 1 Pregnant 2 mos. Exploration and drainage. | Died |
| 8 P | 1 | 1 Torsion several days after delivery. Splenectomy. | Recovery |
| 9 P | 2 | 1 Pregnant 3 days after delivery. Splenectomy. | Died |
| 10 P | 1 | 1 Pregnant 2 weeks after delivery. Splenectomy. | Recovery |
| 14 P | 1 | Total—12 Deaths—5 Recoveries—7 | |
| Total | 51 | | |
| Non-P. | 21 | | |
| Not stated | 16 | | |
| Total | 88 | | |

The autopsy records of two, both in the fifth month of pregnancy are given.

(1) Operative diagnosis, Torsion of pedicle with intestinal obstruction: death sixth day: autopsy: purulent decidual endometritis due to strangulation of intestine.

(2) Operative diagnosis, Torsion of pedicle. Death fifth day. Autopsy: purulent decidual endometritis, endocarditis, hypostatic pneumonia, pulmonary œdema.

spleen was recorded at the time of removal, sixteen had noted splenic enlargement for periods varying from one to seventeen years, the weight of the organ in the twenty-one cases ranging from 400 to 4,200 grams, the average being 1,695 grams. Uncomplicated malarial splenomegaly does not as a rule attain such size, the enlargement in these instances being augmented by the changes incidental to the altered circulation.

Of seventy-two females in whose record the obstetrical history is given, twenty-one are classified as non-parous and fifty-one as parous; of the latter eight were uni-parous, three parous, seven multiparous, while thirty-three had borne from two to fourteen children each. The latter group doubtless forms the basis for the statement that prolapse of the spleen occurs most frequently in women whose abdomens have become inelastic from numerous pregnancies. It is readily granted that flaccidity and relaxation of the abdomen resulting from repeated pregnancies furnish the ideal conditions for such prolapse but a further explanation must be sought in the twenty-one non-parous women and in the five males forming 26.4 per cent of the total number under discussion. The gravity of splenic torsion in the course of pregnancy and the puerperium is graphically shown by the mortality rate of 41.7 per cent. in the twelve cases reported. In two abortions occurred during the acute attack, one before and one after splenectomy, one dying and one recovering. In three torsions occurred after delivery, one dying and two recovering following splenectomy. Of the remaining seven operated on during pregnancy, six by splenectomy and one by exploration and drainage, three died and four recovered.

PREVIOUS HISTORY

| | |
|---|---|
| One or more colics | 19 |
| Abdominal discomfort, digestive disturbance, one with malena | 10 |
| Tumor known to be present, no other symptom mentioned | 25 |
| Tumor known to be present, with colics or discomfort | 3 |
| Pelvic pain and discomfort, 1 with malena, 1 with uterine hæmorrhage | 4 |
| Previous history not stated | 34 |
| | 95 |

DURATION OF ATTACK AT TIME OF OPERATION

| Acute, Under 2 Weeks, 58 | | Chronic, Over 2 Weeks, 37 | |
|---|---|---|---|
| Acute | 58 | 2 mos. | 3 |
| Time stated | 13 | 5 weeks | 1 |
| Chronic—Time not stated | 24 | 4 mos. | 2 |
| | 95 | 4 weeks | 1 |
| | | Several days | 1 |
| | | 8 weeks | 1 |
| | | 2 weeks | 3 |
| | | 1 mo. | 1 |
| | | Time not stated | 24 |
| | | | 37 |

History of acute onset following lifting heavy weight given in seven.

In sixty-one cases there is a history of symptoms antedating the torsion which may be justly ascribed to the splenic displacement, in twenty-eight of which a tumor was known to be present. Colics of mild type, presumably due to partial twists of the pedicle, were noted in nineteen. Digestive disturbances due to pressure and to traction on the stomach, intestine and pancreas were commonly noted in these and were the only symptoms observed in ten. Pelvic discomfort, disturbance of menstruation, vesical and rectal tenesmus have been noted when the spleen occupied a pelvic location. Both metrorrhagia and malena have resulted from pressure and secondary circulatory change.

In thirty-four no symptoms are mentioned other than those noted with the initial attack. The attacks may be classified as acute, subacute and chronic. The symptoms of the acute attacks, barring the known presence of a wandering spleen, offer nothing conclusive other than the presence of a major abdominal disaster. Pain, nausea and vomiting with elevation of pulse, temperature and leucocyte count are usually present. Such an onset with variation in intensity of symptoms is described in fifty-eight cases. In the subacute and chronic varieties the torsion of the pedicle has stopped short of strangulation or the patients have survived the acute onset with the spleen more or less isolated by adherence of omentum and intestine with symptoms directed to the site of the misplaced organ. In instances in which the spleen was known to have been mobile and in others in which a movable tumor had been noted, comment is made upon the rapid enlargement of the tumor following torsion. In thirteen instances the duration of the attack as stated varied from several days to four months while in twenty-four the time is not stated. The description of the findings in the latter group indicates them to be of the chronic type.

LOCATION OF TUMOR

| | | |
|---|---|---|
| Location given | | 85 |
| Right upper quadrant | 2 | |
| Left upper quadrant | 7 | |
| Epigastrium | 2 | |
| Mid-abdomen | 4 | |
| Right half abdomen | 3 | |
| Pelvis and abdomen | 13 | |
| Abdomen | 6 | |
| Right lower quadrant | 9 | |
| Left lower quadrant | 8 | |
| Hypogastrium | 4 | |
| In all four quadrants | 2 | |
| Left half abdomen | 15 | |
| Pelvis | 10 | |
| Location not mentioned | | 7 |
| Tumor not detected, distension and rigidity | | 3 |
| Total | | 95 |

Number palpable through vagina and rectrum, 34

The displaced spleen escaped detection in but three instances, the distension and rigidity effectually hiding it. In seven no mention is made of loca-

tion and in six the tumor is merely described as being in the abdomen. In seventy-nine the tumor is accurately located and it interesting to note that in but seven was it found in the left upper quadrant. The length of the pedicle offers the only limitation to its wandering proclivities, it being found in all parts of the abdomen and pelvis. In the latter it may rest on the uterus forcing the latter into a retroverted position or it may lie in the cul de sac behind the uterus. Mention is made in thirty-four of the histories of the tumor being palpable through the vagina or rectum.

PRE-OPERATIVE DIAGNOSIS

| | |
|---|---|
| Prolapsed spleen or kidney | 1 |
| Kidney | 1 |
| Tumor left kidney or ovary | 1 |
| Hydronephrosis right kidney with twisted pedicle | 1 |
| Appendiceal abscess | 1 |
| Acute appendicitis | 1 |
| Appendicitis with peritonitis | 1 |
| Ovarian tumor | 8 |
| Ovarian tumor with twisted pedicle | 11 |
| Ovarian cyst, twisted pedicle with intestinal obstruction | 1 |
| Hydrosalpinx or tubo-ovarian cyst | 1 |
| Uterine or ovatian tumor | 1 |
| Uterine fibroid | 1 |
| Cyst | 1 |
| Hæmatocele | 1 |
| Tumor omentum or mesentery | 1 |
| Sacrococcygeal tumor | 1 |
| Intestinal obstruction | 1 |
| Peritonitis or obstruction | 1 |
| Peritonitis, indeterminate | 1 |
| Tumor | 9 |
| Spleen | 2 |
| Enlarged spleen | 1 |
| Inflamed spleen | 1 |
| Floating spleen | 1 |
| Floating spleen with twisted pedicle | 1 |
| Wandering spleen | 1 |
| Wandering spleen or hydrated cyst | 1 |
| Wandering spleen, fixed | 2 |
| Movable spleen or peritonitis | 1 |
| Dislocated spleen | 1 |
| Dislocated spleen with twisted pedicle | 4 |
| Diagnosis not stated | 33 |
| Total | 95 |

When one notes the varying locations in which the spleen has been found, in all but seven of which it was widely distant from its normal position, one is prepared for the failures in diagnosis. In thirty-three the condition was recognized as an acute abdominal catastrophe but no pre-operative diagnosis charted. In nine it was tumor of unknown origin. In twenty-three the tumor was thought to have originated in the ovary or uterus. In but nineteen

was the spleen recognized as the organ at fault while in the remainder obstruction, peritonitis, the omentum, appendix and kidney, hæmatocele and sacrococcygeal tumor were suspected. When a history of splenic enlargement or mobility was lacking and the tumor was located other than in the left upper quadrant, its origin was obviously thought to be connected with the organs normally situated at its point of lodgement.

BLOOD COUNT

| | |
|---|---|
| Made | 48 |
| Not made | 47 |
| Total | 95 |

| Before and After Operation, 11 | | After Operation, 13 | |
|---|---|---|---|
| 15500 | Normal in 1 mo. | 17000 – 15000 – 14000 | |
| 28000 | Normal in 4 mos. | 7000 | With decreased lymphocytes |
| 28700 | 10000 | 2 | Increased blood-platelets |
| 13500 | 10650 | 10000 | 4 months later 50000 |
| 7000 | Normal | 14000 – 7000 | |
| 10000 | Increased lymphocytes | 30000 | |
| Normal | Increased white cells | 14400 | |
| Increased whites | Normal | 13760 – 12500 | |
| 12200 | 43000 | Normal | |
| 17800 | 14800 | 14000 | |
| 11300 | 27000 – 10000 | 5600 | |
| | | 30000 – 10000 | |

| | | | |
|---|---|---|---|
| Low Hem. & R. C. Normal W. C. Inc., B. P. | 1 | Increased W. C. | 2 |
| Malarial parasites | 1 | Increased W. C. with parasites | 1 |
| Anæmia. Normal W. C. 3 yrs. later 16000 | 1 | Anæmia of pernicious type with megalo- and normoblasts, poikilocytosis | 1 |
| Low R. C. Normal W. C. | 2 | Normal blood counts | 12 |
| Normal white count | 1 | 8400 before operation, none after | 1 |
| Low R. C. Increased W. C. | 1 | | |

Blood counts at some time in the course of the calamity were made in forty-eight of the ninety-five cases. With but few exceptions the blood study has not been carried out through complete convalescence. Normal counts are reported in a rather surprisingly large number of cases, the inference being that the degree of torsion was not sufficient to produce marked circulatory changes in the splenic tissue. With the acute torsions the number of leucocytes has uniformly been increased, the differential count showing nothing distinctive. Following splenectomy the red cells showed a temporary decrease with rather rapid replacement: the white cells, a gradual decrease with a temporary preponderance of lymphocytes. Increased blood-platelets were recorded in but two. The blood count, as a rule, has regained its normal proportions in from one to four months. In two cases an increased white-cell count was noted long after splenectomy, one of 50,000 at the end of four months, and one of 16,000 at the end of three years: no explanation is offered in either instance.

OPERATIONS

| | |
|---|---|
| Primary splenectomy | 83 |
| Recovered | 66 |
| Died | 15 |
| Result not given | 2 |
| Detorsion and replacement followed later by splenectomy | 2 |
| Total splenectomies (deaths 15, mortality 17.6 per cent.) | 85 |
| Detorsion and replacement (died, 1—mesenteric thrombosis) | 5 |
| Splenoplexy alone (no deaths) | 3 |
| Exploration (closure 1, drainage 1—died) | 2 |
| Total | 95 |

Primary splenectomies were done in eighty-three. Detorsion and replacement were carried out in two cases, both of which later showed acute torsion and were then treated by splenectomy, making a total of eighty-five splenectomies, of which sixty-eight recovered and fifteen died with the result not stated in two, a mortality of 17.6 per cent. Detorsion and replacement constituted the only operation in five with four recoveries and one death, the latter due to mesenteric thrombosis. Splenopexy alone was done in three with no deaths and exploration alone in two, one with drainage and one without drainage, with one death. In the patients treated by splenopexy and detorsion with replacement classed as recovered, no follow-up as to the ultimate fate of the replaced organ is given. The operations which attempt to conserve the spleen when the organ has acquired a wanderlust and become the victim of a torsion must have a very limited scope. The circulatory damage sustained as a result of the twisting of the pedicle, the greatly increased size commonly noted in such organs and the insecurity of any known

SIZE

| | |
|---|---|
| By weight | 53 |
| By measurement | 10 |
| Not enlarged | 1 |
| Enlarged | 11 |
| Not stated | 20 |
| Total | 95 |

Size by Weight in Grams

| | |
|---|---|
| 200–500 | 8 |
| 500–1000 | 13 |
| 1000–1500 | 10 |
| 1500–2000 | 8 |
| 2000–2500 | 7 |
| 2500–3000 | 3 |
| 3000–3500 | 2 |
| 3500–4000 | 1 |
| 4000–4500 | 1 |
| Total | 53 |

Size by Measurement

| | |
|---|---|
| 12x5x9 cm. | 1 |
| 19x9 cm. | 1 |
| 18x11x7 cm. | 1 |
| 21x15 cm. | 1 |
| 37x22x12 cm. | 1 |
| 16x11 cm. | 1 |
| 30x15 cm. | 1 |
| 25x18 cm. | 1 |
| 177x101x114 mm. | 1 |
| 5½x5 inches | 1 |
| Total | 10 |

method of replacement all argue against conservative procedures. The ease with which other tissues rich in reticulo-endothelial cells compensate for its loss invalidates any objection as to a loss of its function. In the light of these considerations splenectomy is to be considered the operation of choice.

The normal spleen varies greatly in size in different individuals and in the same individual under varying conditions. Its average weight is given as 225 grams and its average dimensions at ten centimetres in length, six centimetres in width and three centimetres in thickness. Of fifty-three of the present series whose weight was stated, but eight were under 500 grams, the remaining forty-five varying from 500 to 4,500. In ten in which the size was determined by measurement only, a corresponding increase in size over the normal is indicated. It is evident that circulatory change dependent upon the elongation of the pedicle with malposition induces in the wandering spleen a gradual enlargement aside from that resulting from malarial infection and acute torsion, while, as noted above, the latter accident causes an immediate enlargement due to the intense congestion.

PATHOLOGICAL FEATURES

| | |
|---|---|
| Infarction | 2 |
| Thrombosis of splenic vein with infarction | 2 |
| Old diffuse infarcts | 1 |
| Hæmorrhagic infiltration, with and without necrosis, rents and ruptures | 17 |
| Fibrosis | 4 |
| Enlargement, congestion, hepatization, no gross microscopical change | 17 |
| Chronic congestion with hyperplasia | 4 |
| Malarial splenomegaly | 8 |
| Necrosis with hæmorrhage—no stain | 5 |
| Chronic passive congestion | 11 |
| Pathology not mentioned | 24 |
| Total | 95 |

The pathology reported by the various observers, as far as it relates to the spleen alone, comprises nutritional changes varying from congestion to necrosis superinduced by mechanical interference with the splenic artery and vein.

Four specimens are mentioned as containing blood cysts of appreciable size: eighteen as showing thrombosis of the splenic artery or vein, or of both. One refers to a woman, with recognizable splenic tumor during pregnancy, who two weeks after normal delivery was seized with acute pain and brought to the hospital at the end of the seventh week following labor. Incision showed a cystic tumor from which fourteen litres of thick, brownish pus, sterile on culture, were removed. This was due to a necrotic spleen resulting from dislocation and twisting of pedicle. Recovery followed splenectomy.

In fifteen cases the presence of free fluid was noted in the peritoneal cavity, varying in amount from several ounces to six litres: it was described as colorless and yellow fluid, serum, hæmorrhagic serum, blood and blood-clots. Three of the fifteen showed fatal termination.

The pedicle has been described as of various lengths, the longest being ten inches, the largest compared in size to that of the fetal arm. In all the cases it has been noted as twisted and in sixty an estimate of the torsion given, ranging from one-half to six complete turns. The vessels have been described as thrombotic and as dilated, both artery and vein in some, the vein alone in others. In two the size of the vein was compared to that of the small intestine. In eight the tail of the pancreas is noted as being involved in the torsion, in all but one it being disengaged by detorsion and escape injury; in one it was resected with the pedicle without untoward result.

Seven cases are recorded as showing intestinal obstruction, three involving the small intestine, one the transverse colon and three the sigmoid: two recovered, four died and in one the result was not stated. In the small intestine obstructions, the bowel was adhered to and caught in the twists of the pedicle: the transverse colon was adhered, kinked and compressed: the sigmoid showed volvulus from traction in one, adherence and kinking in one and adherence and compression occlusion in one.

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# ACUTE MASSIVE HÆMORRHAGE FROM DUODENAL ULCER

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The statement is frequently made that "patients rarely bleed to death from duodenal ulcer." This gives the impression that one need not consider this possibility seriously, and that if bleeding occurs, spontaneous cessation can be expected. Ulcers do bleed moderately without alarming sequelæ and many bleed severely with recovery of the patient. On the other hand, we believe that the incidence of fatal bleeding in such cases is greater than commonly supposed. Feeling that the type of ulcer patient who may bleed to death might be more accurately defined, and that with a better understanding of the situation the mortality reduced, we have undertaken a study of such cases occurring in the Massachusetts General Hospital in the past twenty years. It may be added here that fatal hæmorrhage from the gastro-intestinal tract from causes other than duodenal ulcer are not included in this report.

In the period of time covered by this study, 1,804 cases of duodenal ulcer have been treated in the wards of the hospital. Of these, 628 either have a history of gross bleeding or have bled while under observation in amounts recognizable by macroscopical methods. It is likely that a much greater percentage of all ulcer cases have bled some, and it is possible that all of them at some time during their periods of activity have bled slightly. Those with known minor bleeding, 252 cases, have had no secondary anæmia and have responded to the usual medical treatment effective in a large percentage of the whole group. There have been 176 cases classified as moderate bleeders inasmuch as sufficient blood loss had taken place to produce a reduction in red blood-cells to three million and a hæmoglobin below 70 per cent. Most of this group have also temporarily, at least, responded to medical treatment. Occasionally, we find a history of mild or moderate bleeding in previous years among those who have been classified as severe.

In the severe group we have considered only those patients who have bled sufficiently to produce a marked secondary anæmia. There have been 200 such cases. In this discussion we are primarily interested in acute massive hæmorrhage and have divided the severe group into those who have bled gradually over a period of weeks, sixty-two cases, and those whose hæmorrhage has come with sufficient suddenness to produce prostration, shock and marked acute anæmia. There have been 138 of these, 22 per cent. of the whole number of bleeding cases. Of this number, twelve have bled to death without operative interference and eight have been operated upon in a de-

pleted state, none successfully. The mortality, then, is 14.5 per cent. in this group of sudden severe massive hæmorrhage.

It must be added here for the sake of clarity that none of these patients was subjected to surgery until all hope had been lost for a spontaneous recovery.

TABLE I

*Incidence of Severity in Bleeding Duodenal Ulcer*

| | | Cases | Per Cent. |
|---|---|---|---|
| Minor | | 252 | 40.1 |
| Moderate | | 176 | 28.0 |
| Severe | Gradual | 62 | 9.9 |
| | Sudden | 138 | 22.0 |
| Totals | | 628 | 100.0 |

Since we do not wish to be misunderstood, we call attention to the fact that the scope of this paper is confined to the group of 138 cases of sudden severe massive hæmorrhage from duodenal ulcer. How one deals with a bleeding ulcer in the quiescent state will not be taken into consideration at this time. We must segregate these entirely different problems in our minds. In the quiescent state we have a variety of courses from which to choose, but in 14.5 per cent. of the acute massive group we are up against a situation which Balfour[2] has well stated is comparable to that of pulmonary embolism, in which embolectomy becomes justifiable if the patient is obviously dying.

*Anatomy.*—In nearly every fatal case we have been able to demonstrate at operation or autopsy the erosion of a large artery. The ulcer has been on the posterior wall of the duodenum where it overlies the pancreas. It may have started on the anterior wall or superior margin, involving the posterior surface secondarily. At late operation or at autopsy one finds the entire posterior surface of the duodenum missing to the borders of the ulcer and the bed of the ulcer consisting of eroded pancreatic tissue. Either at the superior margin or in the crater of the ulcer one finds a large exposed vessel with an opening of sufficient size to admit an ordinary probe. During operative attempts to cope with this situation, blood spurts from the open vessel at an alarming rate.

The gastroduodenal artery is given off of the hepatic or occasionally from the celiac axis as a separate branch. It runs between the duodenum and the pancreas, dividing into the right gastro-epiploic and the superior pancreatico-duodenal. The inferior pancreatico-duodenal comes from the superior mesenteric and the profuse anastomosis between these vessels behind the duodenum makes it impossible to control bleeding from any one of them without ligation of them all.

In one of the fatal cases, not operated upon, a thrombosis was found in the gastroduodenal artery at autopsy, death having resulted from the flow of blood from the inferior vessels.

The identity of the vessels at operation is so obscured by the surround-

ing inflammatory reaction that one can only hope to intercept them as the tissue about the ulcer is divided. Erosion into the pancreas may have extended sufficiently deep to expose an accessory pancreatic duct, and this in itself may play an important rôle in the further development of the eroded vessels and in the treatment of the ulcer.

*Age.*—The most striking differential point between the cases of apparently the same severity on admission who spontaneously ceased to bleed, and those who bled to a fatal termination, is the average age. In the fatal group, this was 56.3 years and in those who recovered it was 41.8 years. Only two fatalities occurred under forty-nine years of age. One of these was a man of twenty-five who had pulmonary tuberculosis, was a morphine addict and died of hæmorrhage from a duodenal ulcer that had bled profusely on four previous occasions over a seven-year period. The other, a man of thirty-five, was operated upon in a depleted state three days after the onset of profuse hæmorrhage. He had bled moderately ten years before. This difference of approximately fifteen years between the fatal and the recovered group might be expected to be reflected in the chronicity of the ulcer. As a matter of fact, this is not well borne out, as in the recovered group the duration of symptoms was 7.7 years and in the fatal group 8.1 years—an average increase of less than five months. One must explain this lower mortality among the younger group on the basis of more elasticity of vessels and fewer complicating disorders.

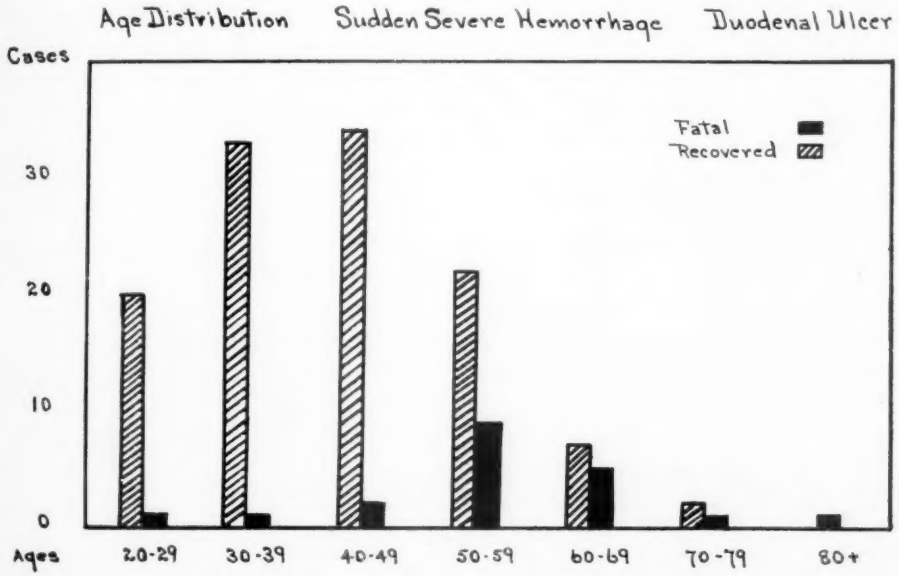
In an effort to define the type of severe massive bleeding case that must be more seriously considered as a possible fatality, we found in the records twenty-four recovered cases that bled alarmingly enough while in the hospital to place in this class. On close analysis, we find only two of these were beyond our average age of 56.3 years found in the fatal group. The average age of these twenty-four cases was 43.5. In the whole group of 118 cases who recovered from sudden severe hæmorrhage there were only fourteen beyond the average age of the fatal group. Of these fourteen cases, three were females, which is relatively a very high proportion for this sex. That is to say, 23 per cent. of women over fifty-six recovered, whereas only 10 per cent. of men over fifty-six recovered. (Graph I.)

*Repeated Episodes of Bleeding.*—It has been more or less commonly believed that patients would be more likely to recover from their first attack of severe bleeding than they would if there had been previous periods of bleeding. Inasmuch as 60 per cent. of our fatal cases died during their first episode of bleeding, it is not safe to rely on the fact that no previous history of such attacks can be obtained. In the twenty fatal cases, twelve had not bled previously, seven had bled once before, and one died during his fifth bleeding attack. We refer to episodes of bleeding which may last several days and not to single hæmorrhages. Of those who recovered, seventy-eight had not bled before, twenty-five had bled once and fifteen had had two or more such attacks. The interval between hæmorrhages varied from four months to twenty-nine years. Of those who have had only one episode of

severe bleeding, fifteen have gone five years, four ten years and three fifteen years or more without further bleeding. Some of these have been protected by surgical procedures done in a quiescent state.

*Time Interval Involved Between the Onset of Bleeding and Death.*—It is interesting to note that in many instances the fatal cases lived several days after their first symptoms of severe massive hæmorrhage were manifested. The patient feels faint and either vomits a large amount of blood, or passes a loose stool filled with blood, or both. He may or may not have had previous warning. Many of the cases have known duodenal ulcers. Many of them have been under treatment and some have had previous surgery. The onset of bleeding may be the culmination of a return of symptoms that have been

GRAPH I




precipitated by a bout of drinking or a definite break in their medical and dietary régime. This may be their only bleeding, which rapidly subsides and leaves them with fewer symptoms than they had previously. Others may have little if any warning, the hæmorrhage being the first indication that all is not well. In the group who spontaneously cease to bleed there may be evidence of two or three periods of bleeding or only one in the first twenty-four-hour period, after which occult blood may be found in the stools for a few days, then they rapidly regain their lost blood so that in a period of three to five weeks they have entirely recovered from the episode.

Those who have fatal hæmorrhage may have exactly the same onset, and seem to be doing well from one to four or five days, only to repeat the profuse hematemesis or melena or both. The majority of the fatal cases have repeated periods of syncope associated with hematemesis or blood by stools in successive attacks with intervals of a few hours to two or three days. It is not always possible to ascertain by the degree of collapse, by the amount

of blood that is recovered from either external orifice, or by the grade of anæmia, whether a patient will fall into the class of spontaneous recovery or go on to a fatal termination. However, there are certain cases that pick up so rapidly after their first prostration that they can be fairly safely segregated from those whose balance may turn one way or the other. In our 138 cases of severe massive hæmorrhage, we believe that ninety-four may, in retrospect, have been predicted a better than average chance for recovery. In the remaining forty-four cases, one cannot make out from a record of their symptoms and condition at entry whether they would be likely to recover or die. We do know, however, that the twenty fatal cases lived in the hospital an average of 13.5 days after entry and lived an average of sixteen days after the initial onset of bleeding. One of them bled so rapidly to a fatal termination that radical surgery was impractical. Two had concurrent conditions contraindicating surgery. One was eighty-one years of age and probably could not have been successfully operated upon. However, there are sixteen cases left, some of whom might have been saved by immediate surgery if the fatal possibility could have been determined soon after admission to the hospital.

*Treatment of Severe Bleeding Duodenal Ulcer.*—It is generally accepted now by a majority of clinicians that gross bleeding in duodenal ulcer is one of the chief indications for surgery. Some of these patients never have a return of bleeding, but many of them do, even after many years of quiescence. It also appears that bleeding ulcer cases are more likely to have recurrences of other ulcer symptoms than the average case on dietary measures.

Jordan and Kiefer[5] have reported from the Lahey Clinic a group of ulcer patients resistant to medical treatment and place bleeding as the most important factor in their failures. If we accept the fact that such cases should be considered surgical in a quiescent state it seems more reasonable to contemplate surgery early in certain severe bleeding cases. Finsterer[4] apparently subjects such patients to radical surgery as soon as the initial state of shock has passed. This has seemed too radical to most of us, as we all dread subjecting a patient to operation during an episode of severe bleeding. The mortality will of necessity be higher than similar procedures done in a quiescent state. On the other hand, if we are forced to operate after a patient has become depleted, a successful outcome will be rare.

It is our belief that a patient entering the hospital with severe massive hæmorrhage from known or strongly suspected duodenal ulcer should be looked upon as a potential fatality. Depending upon the age of the patient and the severity of their bleeding, we will usually be able, within a few hours, to determine whether or not spontaneous recovery can be expected. Both groups should be carefully watched by the medical and surgical services. Those cases who do not rapidly improve and those who have repeated attacks of syncope, hematemesis and melena should be carefully transfused. If they continue to bleed, a large transfusion should be given and immediate operation undertaken. Repeated transfusions may keep these individuals alive for several days but depletion is taking place all the time. It is also possible that

further erosion into the pancreas may be going on. The earlier operative interference can be decided to be justifiable, after the initial state of shock has passed, the more likelihood there will be of a successful outcome. One may feel justified in a less radical operation in the early cases, but this must be determined after the ulcer has been exposed. The bleeding area must be attacked directly and hæmorrhage definitely checked, as palliative procedures are almost sure to fail in this group of patients.

*Transfusion.*—Much has been said concerning the danger of transfusion in acute bleeding ulcer. An analysis of this situation has previously been reported by one[1] of us. There is little evidence that transfusion had any bearing on continued or repeated bleeding. Five cases died of hæmorrhage

TABLE II

*Fatal Cases Operated Upon*

| Age | Sex | Duration of Symptoms Years | Alcohol | Pain to Back | Previous Bleeding | Days Bleeding Pre-entry | Days in Hospital Pre-op. | Trans-fusion | Type of Operation | Death |
|---|---|---|---|---|---|---|---|---|---|---|
| 61 | M | 5 | ++++ | 0 | 0 | 1 | 3 | 0 | Plication of duodenum A. G. E. | 3 hours post-op. - hemorrhage |
| 35 | M | 10 | ++++ | 0 | 1 ( 10 yrs. ago) | 1 | 3 | 1 | Duo. opened, ulcer sutured - A. G. E | 22 hours post-op. - hemorrhage |
| 51 | F | 20 | 0 | 0 | 0 | 2 | 23 | 2 | Antrum opened. Deep sutures placed around ulcer. P. G. E. | 10th day post-op. - massive hemorrhage |
| 52 | M | 4 | 0 | + | 1 ( 2 yrs. ago ) | 21 | 11 | 5 | Bilroth II | 17 hours post-op. - hemorrhage |
| 58 | M | 10 | 0 | 0 | 0 | 3 | 3 | 2 | Resection attempted | on table - hemorrhage |
| 49 | M | 12 | ++ | + | 0 | 3 | 16 | 1 | Duo. opened attempt to control bleeding | on table - hemorrhage |
| 67 | M | 6 | 0 | + | 1 ( 2 yrs. ago ) | 3 | 29 | 7 | Bilroth II | 18 hours post-op. - shock |
| 54 | M | ½ | 0 | + | 0 | 6 | 5 | 6 | Modified Polya Control of bleeding during operation | 4th day Pancreatitis subdiaph. abscess |

without transfusion, having been in the hospital thirteen, ten, seven, five and one-half days, respectively, before death. Patients that bled out several transfusions in a period of from one to five days all resulted fatally whether operated upon or not. It is our belief that everything should be ready for transfusion, either matched citrated blood at hand, or a donor within the hospital, and blood given the patient only on his failure to hold his own with a systolic blood-pressure above 70 millimeters of mercury. If the pressure has fallen below this level, death may take place so rapidly that there is not time for transfusion. The blood should be given slowly in moderate amounts of about 300 cubic centimetres. If so done, there is no danger of rapidly elevating the blood-pressure. Many cases have responded well to this treatment with no further serious bleeding during the episode. After the patient is safely over the acute stage of hæmorrhage (five to seven days)

blood transfusion will materially shorten his hospital convalescence. Operation should be considered and undertaken in a large percentage of the patients who rapidly lose the benefits of transfusion. (Tables II and III.)

*Surgery in the Depleted State.*—Unfortunately, certain cases enter the hospital in a depleted state, and others, owing to mistakes in judgment, are allowed to reach a very precarious condition even after hospital entry. Under such circumstances we are forced to either look upon the situation as hopeless or to make some heroic attempt to save a life. Watchful waiting and late surgery have each been tried in the twenty fatal cases included in this study. Twelve have died without surgical interference. Four of these were justifiable either from the standpoint of complicating diseases, old age or from lack of

TABLE III

*Fatal Cases Without Operation*

| Age | Sex | Duration of Symptoms Years | Alcohol | Pain to Back | Previous Bleeding | Days Bleeding Pre-entry | Days in Hospital | Transfusion | Remarks | Death |
|---|---|---|---|---|---|---|---|---|---|---|
| 58 | F | 15 | 0 | 0 | 1 | 3 | 33 | 1 | Bled slightly for 1 mo. then transfused. | 2 days later |
| 63 | M | 10 | 0 | 0 | 1 | ? several | 32 | 3 | Entered for abd. pain-G.U. serv. Ulcer thought quiescent.Cystotomy for stones. | Sudden hemorrhage.duo-ulcer. 2 wks post-op. |
| 81 | M | 1 day | 0 | 0 | 0 | 1 | 4 | 1 | Little improvement from trans. Continued bleeding. | 2 days later |
| 69 | M | 20 | 0 | 0 | 1 | 1 | 13 | 0 | Not trans. Op. to have been done day of death. | 20 hrs. after ba. meal |
| 54 | M | 3 | +++ | + | 1 | 10 | 8 | 0 | Op. advised by surgeon. Vetoed by physicians. | sudden de - cline.No Transfusion |
| 25 | M | 7 | +++ morph. | 0 | 4 | 1 | 10 | 0 | Bilateral Pulmonary T.B. | Sudden G.I. hemorrhage |
| 49 | M | 10 | +++ | 0 | 0 | 1 | 5 hrs. | 1 | Arrived bled out. Transf. Bled out 2 hrs. Diabetic | 5 hours after adm. |
| 69 | M | 1 | 0 | 0 | 1 | 0 | 17 | 1 | Severe bleeding on ward. Transfusion. | 24 hrs. after transfusion |
| 51 | M | 8 | + | 0 | 0 | 0 | 9 | 1 | attempt made to get him in operable state | Erosion of pancreatico-duo. artery |
| 54 | F | 0 | 0 | 0 | 0 | 0 | 49 | 3 x a day. | Resection hemangio-endothelioma of colon. | duo. ulcer - hemorrhage |
| 56 | M | 3 | ++ | 0 | 1 | 10 | 6 | 1 | Transfusion. Sudden failure from hemorrhage. | Erosion of Pancreatico-duo. artery |
| 71 | M | 10 | 0 | 0 | 1 | 4 | 1 | 0 | Arrived bled out. | 24 hrs. after admission |

time after entering the hospital. Eight were subjected to surgery in an attempt to stop the bleeding after all hope of spontaneous recovery had been abandoned. Two bled to death during the operation. Four died within twenty-four hours. One died of pancreatitis, subdiaphragmatic abscess and bronchopneumonia on the fourth day. One died of recurrent hæmorrhage on the tenth day.

If one of this group in a depleted state is going to be rescued by surgical measures, we must be prepared to meet the situation in a logical manner. Given an open large vessel behind the duodenum on an eroded area in the pancreas, one must be willing to obtain exposure and intercept the vessels that enter the ulcer outside of the ulcer bed. Attempts at controlling this type of bleeding by sutures, by cautery, or by simple gastroenterostomy

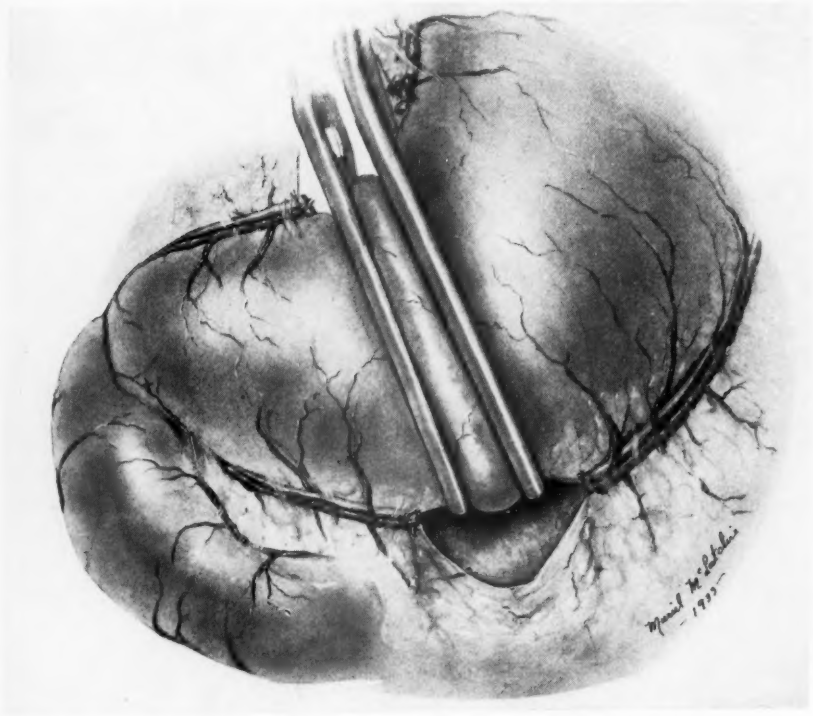


FIG. 1.—The stomach is divided between crushing clamps.

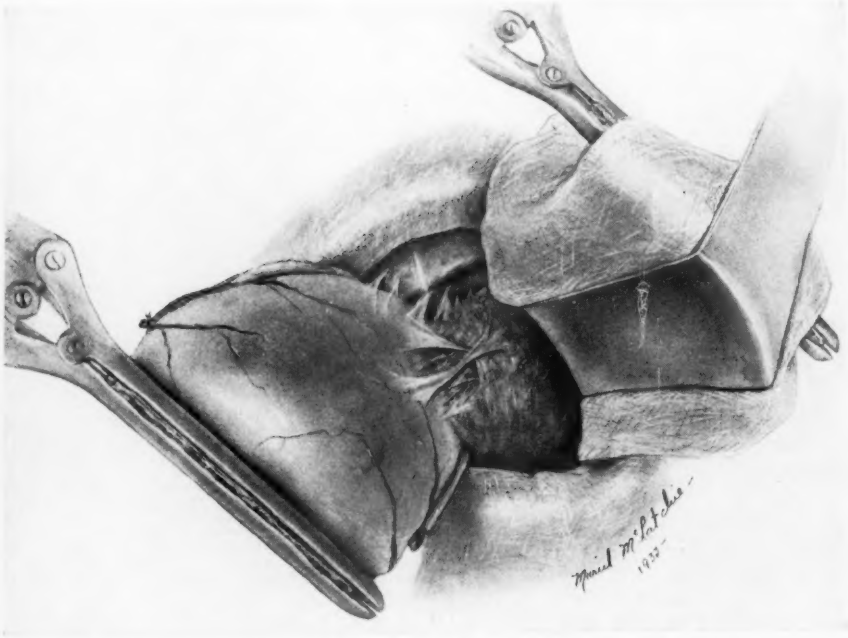


FIG. 2.—The distal segment is freed down to the adherent portion of the ulcer.

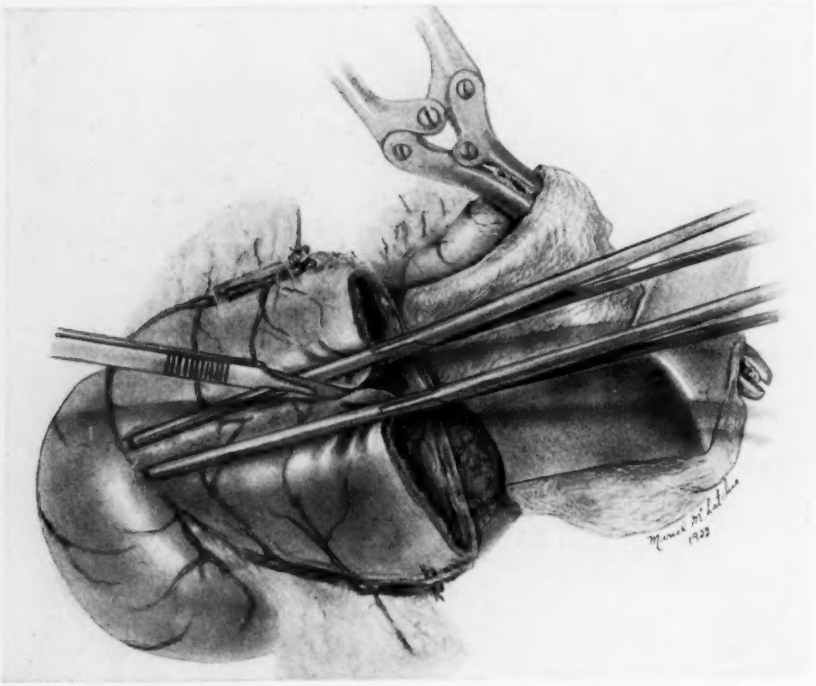


FIG. 3.—The anterior wall of the distal segment is opened through the pylorus.

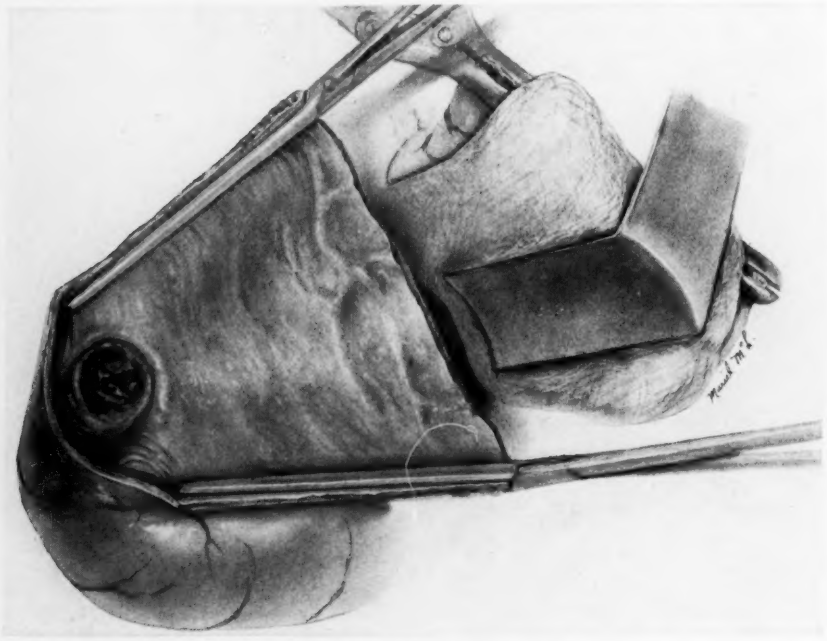


FIG. 4.—The ulcer is widely exposed.

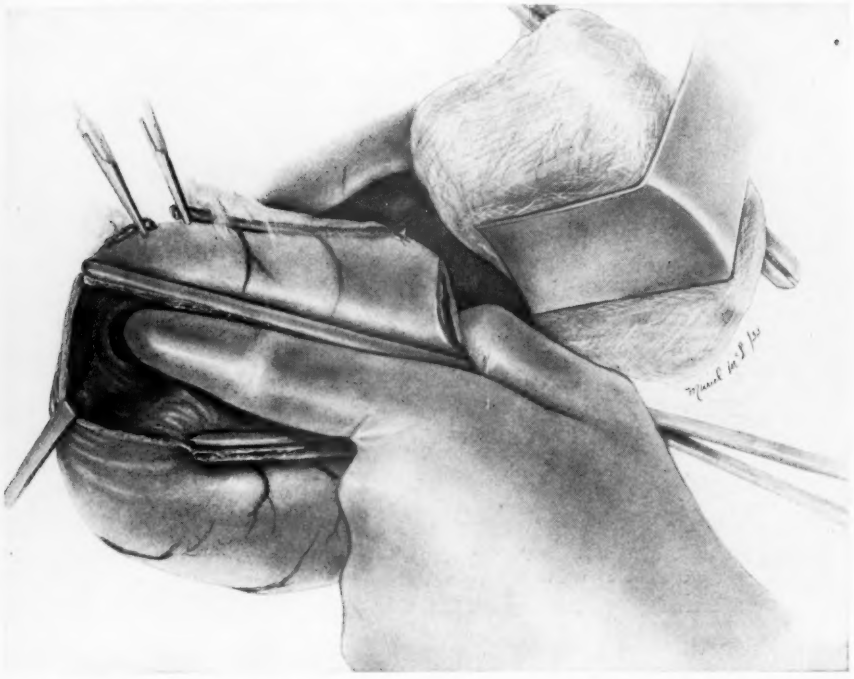


FIG. 5.—The bleeding vessel can be controlled by pressure of the operator's index finger. A tamponade held by an assistant is a second-best method of control. Note the retractor exposing the ampulla of Vater.

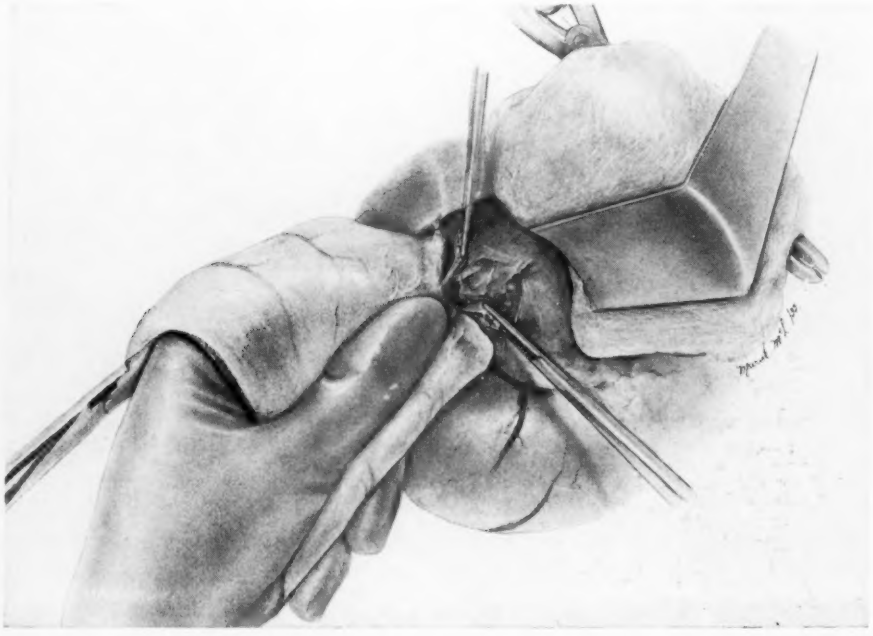


FIG. 6.—The vessels entering the ulcer area can be secured, as the adhesions about the ulcer are divided. It is important to avoid breaking into the ulcer area from behind—if the ulcer is to be inclosed, as shown in Fig. 8.

without a direct attack upon the ulcer will probably fail. In order to control the loss of blood during the operative procedure one may rapidly transect and free up the lower third of the stomach down to the ulcer. (Figs. 1 and 2.) Then remove the distal clamp and open wide the anterior wall of

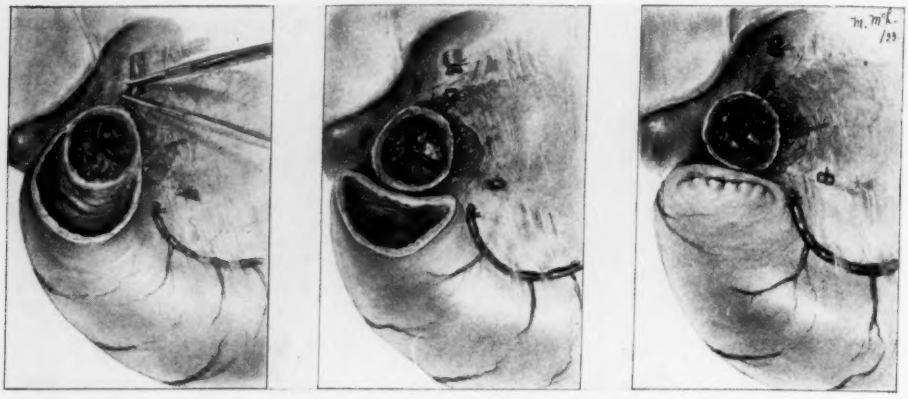


FIG. 7.—The ulcer can be left exposed if not too large and too deep. A large deep erosion in the pancreas is a menace to leave exposed within the peritoneal cavity.

the lower segment so that the ulcer is in clear view. (Figs. 3 and 4.) Having done this the bleeding point can be kept controlled by a finger or tamponade (Fig. 5) and the resection continued without further serious loss of blood. The vessels entering the edge of the ulcer are intercepted as

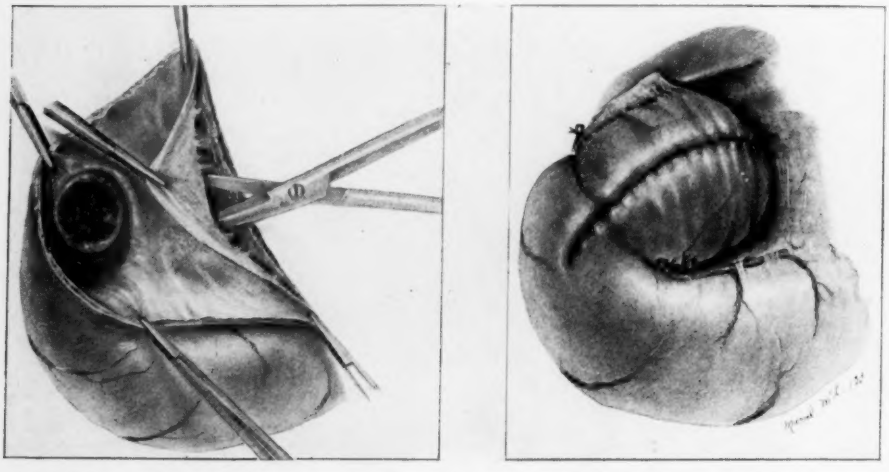


FIG. 8.—A method of enclosing the ulcer within the duodenum after the vessels have been secured from the outer area. Part of the distal segment of the stomach has been discarded, leaving sufficient for easy suture. The mucosa can be removed from the remaining antrum, to dispose of the acid-activating cells.

the inflammatory tissue is cut across. (Fig. 6.) Having the hæmorrhage controlled one can place a retractor in the duodenum and ascertain the level of the ampulla of Vater. If there is room to free the duodenum beyond the ulcer bed and allow a satisfactory turn-in, the operation is easily completed. (Fig. 7.) If one is in doubt concerning this or if the erosion in the pancreas

is of large size and sufficiently deep to have opened an accessory pancreatic duct, then a modified procedure can be done. A part of the elevated distal portion of the stomach may be eliminated, leaving a sufficient amount of the pre-pyloric region for easy suture. One can then suture the duodenum and stump of the stomach in such a way as to enclose the ulcerated area in the pancreas. (Fig. 8.) If one is anxious to destroy the remaining activating area in the antrum, and the patient's condition permits, the mucosa can be removed from this region as suggested by Bancroft[3] before the closure is made. Anastomosis between the stomach and bowel may be made by the Polya or Billroth II method. That these procedures are practical in certain cases we have demonstrated. One patient, having bled for ten days and having had five transfusions, lost so little blood on the table that his condition actually improved during the operation. He lived four days and at autopsy we found considerable fat necrosis and a collection of seropurulent material above the liver. Here we felt in retrospect that the modified procedure enclosing the large ulcerated area in the pancreas might well have resulted in a successful outcome. In another severe case of massive hæmorrhage operated on in a quiescent state three weeks after the onset of bleeding, the modified technic was successfully carried out. Of course, there are difficulties in these procedures. The space between the superior margin of the duodenum and the liver is foreshortened, making it easy to damage the common bile-duct and other structures in this vicinity; but by working from the stomach side it becomes possible to intercept with comparative safety the vessels entering the ulcer area.

It is essential that one must plan this procedure carefully beforehand, as the average surgeon will have very few opportunities during his entire experience to use it. We believe that the operative failures in our group of cases are partially due to the fact that several surgeons are involved.

*Conclusions.*—(1) It would seem from a review of our cases that duodenal ulcer patients who have recovered from a severe hæmorrhage should be subjected to surgery in a quiescent state, as the possibility of a persistence of symptoms is great and the incidence of future episodes of severe hæmorrhage is about 40 per cent. Spontaneous recovery is less likely with increasing age. Surgical procedures indicated in the quiescent group are not discussed here.

(2) About one-third of all our duodenal ulcers requiring hospitalization have gross bleeding. Over 3 per cent. of all of our gross bleeding cases died of hæmorrhage. Our mortality in sudden massive bleeding from duodenal ulcer was 14.5 per cent., regardless of treatment.

(3) Age seems to be the most striking single factor in determining the possibility of spontaneous recovery. Death from hæmorrhage rarely occurs in patients under fifty.

(4) Individuals with acute massive hæmorrhage from duodenal ulcer should be carefully watched. If they are beyond middle age and do not show early evidence of complete cessation of bleeding, as indicated by a careful check of blood-pressure, stabilization of anæmia, rapidly clearing

stools, lack of hematemesis, disappearance of pain and tenderness, and rapid improvement in general condition, immediate surgery should be seriously contemplated.

(5) Matched citrated blood should be kept in the refrigerator or a donor held in the hospital. This should be used quickly if there is a second collapse and before the systolic pressure falls below 70 millimetres of mercury. If there is a rapid loss of the benefits of this transfusion, a large transfusion should be given and the patient immediately operated upon. The less delay in operation on this type of patient, the better his chance of withstanding the procedure, due to the fact that his reserve is not entirely depleted. Transfusion, although a life-saving procedure and a useful adjunct to a successful outcome, will not replace all of the elements that the patient has lost over several days of bleeding and starvation. Individuals rarely recover if blood loss is sufficient to require five or six transfusions, especially if associated with starvation over a period of several days.

(6) Patients who continue to bleed should be expected to have a large open vessel, situated in an eroded area in the pancreas. A method of attack in such cases is described. It is our feeling that an operative effort should be made in these patients, unless there are overwhelming contra-indications to surgery.

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Discussion.—Dr. Frank H. Lahey (Boston, Mass.) said that Doctor Allen has in his paper some of the figures which were compiled from the follow-up figures in the Lahey Clinic ulcer series in an endeavor to investigate how bleeding indicates that such ulcer patients will not do well medically. Doctor Kiefer in that clinic followed 800 cases of duodenal ulcer with this in view. Of a series of sixty cases that had had a history of one attack of bleeding, 40 per cent. failed under medical treatment. In twenty cases in whom there was a history of two hæmorrhages, 85 per cent. failed under medical treatment. Of those twenty cases that failed under medical treatment, recurrent hæmorrhage occurred in thirteen of the cases.

Therefore, they have come to believe that a history of two hæmorrhages previous to coming to the Clinic is indicative of probable failure under medical treatment. He felt very definitely that one can cut down this mortality of bleeding ulcers if one accepts two or more hæmorrhages as an indication that radical surgery must be done on these cases. He reported at the last meeting of the New England Surgical Society that their mortality from unoperated bleeding ulcers was 2 per cent. That is wrong because that included all of the cases that bled. Actually, if one takes the eighty cases that bled after they got into the hospitals, because the others had bled before coming in and so could not be counted, four died. So the danger of fatality from bleeding ulcers in the

hospital is certainly 5 per cent. That is a really serious mortality rate from this complication.

Dr. Edward B. Benedict called attention to the fact that four of these cases also perforated, three of them some time after a severe hæmorrhage, and one two years prior to it. It is so frequently said that bleeding ulcers do not perforate and that perforating ulcers do not bleed that this incidence of 3 per cent. perforation in severely bleeding ulcers is of some importance. In most instances it probably means multiple ulcers, with bleeding from an ulcer of the posterior wall at one time, and perforation from an ulcer of the anterior wall at some other time. In one case, however, the perforation occurred only four days after a very severe hæmorrhage.

Dr. Daniel Fiske Jones (Boston, Mass.) remarked that internists are holding onto the bleeding ulcers too long. They are afraid to have them operated upon, and the surgeon is responsible for that, for it has been said by surgeons that cases of acute hæmorrhage should not be operated upon. He thought that the value of transfusions has been overestimated by many. They do not appreciate that with each transfusion a less good effect is obtained. The third and fourth, if they come within a few days of the first and second, seem to have little or no effect. He thought the rule made by the surgeons some years ago at the Massachusetts General Hospital to be a very good working rule. The patient was to be seen by the surgeon, and if the patient had to be transfused a second time within forty-eight or seventy-two hours he should be transfused and operated upon immediately. This may seem radical to some, but he was sure that they could save more patients by operation after a necessary second transfusion than they are saving at present by making a hard and fast rule that no patient should be operated upon for acute hæmorrhage.

Dr. Frederic W. Bancroft (New York City) asked Doctor Allen in closing to tell the mortality of his operative cases. He said 14 per cent. of all cases.

Dr. Arthur W. Allen (Boston, Mass.) said in answer to Doctor Bancroft's question, all of these cases in this group died, operated or unoperated because they were all kept in the hospital until they had reached a stage where they were moribund before they were turned over to the surgeon.

Of course, there have been a great many successful cases where the surgeon has been able to get hold of the cases early. The mortality in those cases operated on early is about what it is for ordinary pylorectomy for ulcers.

# PANCREATIC EMERGENCIES

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of Baltimore, Md.

This communication has to do with those abdominal emergencies that have their origin in the pancreas. We shall, therefore, concern ourselves only with those affections of that organ which, upon occasion, may require immediate surgical aid. In reviewing the literature of diseases of the pancreas, in the preparation of this paper, we were impressed with the number and character of the communications on this subject that have been presented by Fellows of this Association, past and present.

For the sake of brevity, and because it would be quite out of place before this audience, I shall omit extended reference to the anatomy and physiology of the pancreas. It will suffice for our present purpose to call attention to a few facts that have a direct bearing upon the subject under discussion.

Only in recent years has the importance of the pancreas, physiologically, pathologically and surgically, come to be estimated at anything like its true value. This was due largely to its deep anatomical situation, its peculiar structure, the arrangement of its ducts and the fact that its double function was for so long a time not understood. Furthermore, the close relationship existing between affections of the pancreas and diseases of the neighboring digestive organs, especially of the biliary tract, greatly exaggerated the difficulties experienced in making a differential diagnosis between affections of these organs. In common with the ductless glands, of which it was formerly thought to be one, little attention was paid to the pancreas by the earlier anatomists and physiologists. Not until Wirsung, in the early part of the seventeenth century, discovered that it had a duct, did it begin to attract particular attention. This discovery made possible at least a partial explanation of its function. Langerhans early called attention to certain peculiarities in its anatomy, but not until recent years has the true significance of the histological structures which bear his name been fully understood. Of the organs that have to do with digestion, the pancreas is one of the most vital, since the substances secreted by it, both external and internal, are necessary to the well-being of the human organism—in fact, to the continuance of life itself. Scattered cases, however, have been reported where apparently the entire pancreas has become necrotic as a result of acute hæmorrhagic pancreatitis, and has been removed as a slough, without any untoward results, either immediate or remote. I have myself seen two such cases. The only satisfactory explanation of this phenomenon is either that all the pancreatic tissue was not removed, or the presence of accessory glands. There is abundant experimental evidence to prove that the total loss of the pancreatic secretions, as in the case of complete removal or destruction of the gland, is quickly fatal, whereas the long-continued loss of gastric juice, even the com-

plete removal of the stomach itself, or the complete blocking of the flow of bile, may all be borne for varying lengths of time without serious effect upon the animal economy.

The majority of pancreatic emergencies may undoubtedly be classified under the head of acute pancreatitis, the mechanism of the production of which will presently be discussed. Let us, however, first direct our attention to certain other potential sources of trouble in the pancreas, which, upon rare occasions, may give rise to emergencies or near emergencies, necessitating prompt surgical intervention, *e.g.*, certain congenital anomalies, trauma, pancreatic calculi, cysts, pseudo-cysts, tumors, and even that interesting recently described condition known as hyperinsulinism, which may exhibit such alarming symptoms as to demand immediate operative relief.

The occasional presence of certain anomalies should always be borne in mind, *e.g.*, accessory pancreas, single or multiple. They are usually found in the muscular walls of the stomach or jejunum. If situated at the pylorus, their presence may give rise to congenital hypertrophic stenosis. Hale reports such a case. Cystic or adenomatous tumors of the gland may rarely become pedunculated, and hence subject to twisting of the pedicle. I have had one such case where, owing to the extreme mobility of the tumor, a correct preoperative diagnosis was not made.

The relationship of the common bile-duct to the head of the pancreas is not at all constant. It varies from a very loose attachment to passage through the substance of the gland for some distance. In rare instances, the duodenum itself may pass through the head of the pancreas and be completely surrounded by it. This anomaly may give rise, in the case of either acute or chronic pancreatitis, to a potential obstruction of the duodenum that may require emergency surgical relief.

Like other abdominal organs, the pancreas is subject to trauma, but, unlike most of the others, owing to its relative inaccessibility and the protection afforded by the bony skeleton and adjacent structures, it is not often that it suffers serious harm, except in the case of the severer types of crushing injuries, or in penetrating wounds. There are, however, to be found in the literature a number of cases in which the pancreas has been lacerated or even torn asunder, thus necessitating immediate surgical interference.

Owing to its vascularity, such injuries are accompanied by immediate evidences of hæmorrhage and shock, while the characteristic deleterious effects of the escaping pancreatic ferments upon the surrounding structures begin quickly to manifest themselves. In cases of severe trauma with or without an open wound, where inspection does not at once reveal an injured pancreas, the possible presence of this complication should be suspected, especially if excruciating pain referred to the upper abdomen, together with profound shock and other evidences of hæmorrhage, are present. The intensity of the shock and pain accompanying the trauma, as in the case of acute pancreatitis, are characteristic features of this condition. The examination of the urine may throw some light upon the question of possible pancreatic injury, as the presence of a mild glycosuria is always suggestive.

In the case of a penetrating or lacerated wound exhibiting the clinical picture just described, an immediate exploratory incision would appear to be indicated, the results of which should determine at once the remedial measures necessary. As a rule, little can be done other than to stop the hæmorrhage, which generally is quite profuse and, owing to the friability of the gland, quite difficult to control. Having accomplished this by ligature, suture or gauze packing, as may seem best, closure of rent with a few sutures and provision of drainage for the escape of the pancreatic secretion is indicated.

Among other rare conditions which provide potential emergencies, although seldom actually presenting them, may be mentioned calculi in the ducts of Wirsung or Santorini, or even in the ampulla of Vater. These may give rise to symptoms somewhat analogous to those commonly associated with biliary calculi. The extreme rarity of pancreatic calculi is responsible for the fact that the possibility of their presence is rarely given due consideration in the differential diagnosis of acute abdominal emergencies. There seems to be no distinctive clinical picture upon which to base a diagnosis. The X-ray may be helpful, but here again it is difficult to distinguish with certainty between pancreatic calculi and those of biliary origin. The presence or absence of jaundice is too uncertain to be of any great diagnostic value. A study of the reported cases, including one of our own, seems to show that, beyond the deep-seated, boring character of the pain, the absence of severe nausea and vomiting, as compared with that usually met with in biliary calculi and acute pancreatitis, nothing very characteristic is to be noted. The pain, starting in the epigastrium, radiates rather to left side, perhaps, than to right, as in the case of gall-stones. Evidence of pancreatic deficiency may be observed on examination of stools. Diagnosis, if made at all, is usually arrived at by a process of exclusion. Removal of the stones is, of course, indicated. This is accomplished through incision into the body of the pancreas. Drainage of the biliary tract, or removal of the gall-bladder, is also indicated.

Pancreatic cysts, although of relatively infrequent occurrence, may arise from a variety of causes, which we will do no more than mention here—congenital; proliferation, adenoma and carcinoma; hæmorrhagic; dermoid; hydatid; retention and pseudo-cysts. It is not, however, so much the nature of the cyst that is of importance clinically, as its size, relationship to surrounding structures and its liability to certain accidents. It is these secondary characteristics rather than the primary cause that are of surgical significance. The cause of the sudden enlargement frequently noted in these cysts is usually due to hæmorrhage. This in itself may give rise to urgent symptoms—pain, nausea, vomiting, and, in the case of severe hæmorrhage, symptoms associated with loss of blood. Trauma is a very important factor in the etiology, especially in the case of pseudo-cysts. The diagnosis is not always easy, since it must be differentiated from other cysts having their origin in the neighboring organs. Pancreatic cysts are observed more often in the third and fourth decades of life, and more frequently in women. Often there is to be obtained a history of previous trauma. Even before the appearance of a tumor, there may be vague gastro-intestinal disturbances. As the growth enlarges, pres-

sure symptoms and increasing pain, indigestion, obstruction, rapid loss of weight and jaundice, some or all of them, may make their appearance. The tumor presents in the mid-epigastric region, and since it has its origin usually in the body or tail of the gland, is found slightly more often to the left. Its outline is usually symmetrical and elastic, and it may fluctuate. Imperative indications for operation are massive hæmorrhage from erosion of vessels in the cyst wall producing sudden enlargement of the cyst, accompanied by severe pain and possibly collapse. The operation consists of enucleation where possible, marsupialization, or drainage by the most convenient avenue of approach. The prognosis, on the whole favorable, depends largely upon the type of cyst and the underlying pathological factors.

One of the rarer pancreatic emergencies is duodenal obstruction resulting from tumor of the head of the pancreas, usually carcinoma. The chief complication resulting from this condition is, of course, obstruction to the common bile-duct, with the classical symptom-complex described by Courvoisier, and bearing his name, for which cholecyst-gastrostomy is usually indicated. The duodenum, however, owing to its intimate relationship to the head of the pancreas, may share with the common duct in the resulting obstruction. A number of such cases have been reported. In one of my own, I found it necessary to do both a cholecyst-duodenostomy, which I found I could do as easily as a cholecyst-gastrostomy, and, after nearly two years' interval of complete relief, it became necessary to do a hurried gastro-enterostomy, because of obstruction of the duodenum, due to the advancing growth of the tumor in the head of the pancreas. Obviously, this type of obstruction is seldom met with, and when it does occur, is usually gradual in its onset. In rare instances, however, as in my case just referred to, the obstruction may present sudden and grave symptoms sufficient to assume the character of an abdominal emergency. The clinical picture, of course, is that of a high duodenal obstruction. The diagnosis presents no real difficulty. The immediate relief is usually satisfactory, but, owing to the nature of the primary cause, the ultimate prognosis is bad.

As indicated at the beginning of this paper, acute pancreatitis furnishes the most frequent and important pancreatic surgical emergency. Its etiology has given rise to much discussion and animal experimentation. The consensus of opinion seems to be that, while it may rarely be found following trauma, or associated with various infections, typhoid fever, appendicitis, influenza and mumps, it owes its origin chiefly to the presence in the pancreatic ducts of a chemical substance or substances which have the property of activating certain ferments normally present in the pancreatic secretion. The chief point in the discussion is the special mechanism by which this is accomplished.

As far as can be ascertained, the process is substantially as follows, and is based directly upon the anatomical relationship of the pancreatic ducts to the common bile-duct and its outlet into the duodenum. Subject to certain variations, the ducts of the pancreas known by the names of their distinguished

discoverers, the ducts of Wirsung and Santorini, anastomose with the common bile-duct through a short common channel, the diverticulum of Vater, which in turn is also subject to certain variations, or it may be entirely absent. The significant feature of this arrangement is the fact that, under certain conditions, for instance, a spastic contraction of the sphincter of Oddi, as insisted by Archibald, or the presence of a small calculus in the diverticulum, as demonstrated by Opie in Halsted's case, its orifice may be so obstructed as to convert the two ducts into a common and continuous passage through which the bile, possibly infected, or mixed with intestinal contents, may be forced backward into the body of the pancreas. The most important factor in bringing about the resultant destructive effect upon the pancreas, namely, the rapid œdema, hæmorrhage and subsequent necrosis, which occurs almost immediately, is the bringing together within the body of the gland a mixture of pancreatic juice which contains, among other active ferments, trypsinogen, and certain activating substances, such as bile, whether infected or not, and calcium, which is present in tissue exudates and blood-plasma. As Archibald has pointed out, the pathological process is primarily a chemical necrosis, with the inflammatory changes purely secondary.

In this connection, I wish to report a series of thirty-two cases of acute pancreatitis that have been observed in the Johns Hopkins and Union Memorial Hospitals in Baltimore. I am indebted to Dr. W. F. Rienhoff, Jr., for the collection and classification of the Johns Hopkins cases, and to Dr. J. M. T. Finney, Jr., for a like service in connection with those of the Union Memorial. In analyzing these two groups, and comparing them with similar series of cases reported by other observers, now aggregating a number sufficiently large from which to draw fairly definite conclusions, certain rather striking facts at once become evident. First, the comparative infrequency of the condition is worthy of note. In the Johns Hopkins, from 1889–1932, out of a total of 78,000 admissions, only eighteen cases of acute pancreatitis were observed. In the Union Memorial, from 1920 until 1933, there were fourteen cases out of a total of 40,350 admissions, giving a total of only thirty-two cases of acute hæmorrhagic pancreatitis out of 118,350 consecutive admissions in two large general hospitals. It is, of course, possible, indeed highly probable, that other cases were not recognized, in view of the rather surprisingly small number in which a correct pre-operative diagnosis was made. This latter fact is perhaps not so surprising after all, for the very infrequence of acute pancreatitis renders it liable to be overlooked when it does occur. The close association between the pancreas and the other organs of digestion, and the masking of its symptoms by those of various disorders of neighboring organs which closely simulate them, tend still further to confuse the diagnostic picture.

An analysis of the various case histories in our series shows that the outstanding symptom was pain of sudden onset, and described as deep-seated and agonizing in character, which followed, as a rule, a heavy meal. It was present in every one of the thirty-two cases (100 per cent.). In the vast majority of cases, the pain was referred to the epigastric region, just

below the tip of the xyphoid cartilage, possibly somewhat to the left of the mid-line. Rarely was the pain referred to the back or to the right side. Tenderness and muscle spasm, while noted in a few cases, were not a marked feature. Next in frequency came nausea and vomiting, with a distressing hiccough, profuse sweating, great prostration and shock, which were present in twenty-eight cases, or over 90 per cent. Jaundice was observed in twelve cases, or in over 36 per cent. Cyanosis, the symptom upon which Halsted laid such stress, was noted in only five cases, and a palpable mass was to be made out in only three cases.

There was a history of previous affection of the biliary tract of some form in over 40 per cent. of cases. The leucocyte counts averaged consistently high, varying from 12,000 to 40,000.

At the operation, a serosanguineous exudate was found present in the abdominal cavity in seventeen cases, or over 52 per cent. Fat necrosis was observed in twenty-four cases, or over 76 per cent. These percentages conform very closely to those given in other published series. The mortality rate for the series was 37.2 per cent., that for women 25 per cent. and for men 50 per cent., which bears out the idea of relative immunity to abdominal infections generally believed to be enjoyed by women over men. The general average of the cases reported shows that the sexes were about evenly affected, although in our own series the women slightly predominated.

In the light of the quite definite clinical picture of acute pancreatitis thus presented, it seems rather strange that it should not have more often been recognized before the abdomen was opened. To be sure, as has already been intimated, the picture is apt to be obscured by a history of symptoms suggestive of certain other acute abdominal affections—acute perforating ulcer of the stomach or duodenum, gall-stone disease, intestinal obstruction, acute appendicitis, renal colic, ruptured ectopic pregnancy, diaphragmatic pleurisy, to which should be added certain cases of acute poisoning, and, strangely enough, certain cardiac conditions, such as coronary thrombosis or rupture of the left ventricle, which may at times present a clinical picture almost indistinguishable from an acute abdominal crisis.

From this recital of pathological conditions, to which consideration must be given in making a differential diagnosis, the difficulty in reaching a correct conclusion becomes at once apparent. If, however, in approaching a case exhibiting symptoms of an acute abdominal crisis, one will be sure to bear in mind that acute pancreatitis, even although of relatively infrequent occurrence, has always to be reckoned with, one will be much less likely to overlook it.

Since early recognition of acute hæmorrhagic gangrenous pancreatitis is of prime importance, and since in the majority of cases the clinical picture is, as we believe, sufficiently clear-cut to allow of its prompt recognition if sufficient care is taken in working up the case history and physical examination, let us review briefly some of the more characteristic of the clinical signs of this emergency, lest we forget. The most constant and distinguishing

feature of acute pancreatitis is the sudden agonizing character of the abdominal pain and its persistent reference to a point just below and possibly to the left of the tip of the xyphoid cartilage. Add to this the profound prostration, the persistent nausea and vomiting, the absence of marked tenderness and board-like rigidity of the abdominal muscles so characteristic of acute perforations of the hollow viscera, the occasional presence of a palpable mass, slight glycosuria and the history of previous attacks of supposed biliary troubles. Given this particular clinical syndrome, the possibility of the presence of acute pancreatitis should at once suggest itself.

In considering operation upon the pancreas, there are certain characteristic features peculiar to this organ that must be borne in mind by the surgeon—since they tend to limit his field of activity—for instance, its comparatively difficult approach; the friability of its tissues; its anatomical structure; its relationship to neighboring organs; the size, number and thin walls of its vessels, which greatly increase the risk of hæmorrhage and also the difficulty in its effective control. Then, too, the digestive action of the pancreatic secretions and their irritative effect upon the peritoneum, fat and other structures, especially their digestive action upon adhesions, which are the principal safeguards against the spread of peritoneal infection, will unfavorably influence the end-results of surgery. While the truth of the foregoing statement is undoubted, it is also a fact that the overemphasis, perhaps, placed by Mikulicz and other earlier observers upon the dangers attending pancreatic surgery was largely responsible for the delay in its development and the rather widespread impression among surgeons generally that the pancreas constituted a sort of *"nolle me tangere"* in surgery. This impression, which undoubtedly did materially retard the development of pancreatic surgery, has, owing to increased knowledge of the subject, been largely dissipated, and the pancreas now takes its place among other structures of the body as quite amenable to properly controlled surgery. There still remains among surgeons a difference of opinion as to the best treatment for acute pancreatitis. The chief point at issue is whether or not the capsule and the tissues of the gland itself should be incised. The operation of choice in our series was evacuation of the bloody fluid free in the abdominal cavity, with exposure of the pancreas either through the gastrocolic or gastrohepatic omentum, as seemed best. In some cases, the capsule was incised, in others not. So far as the results were concerned, there seems to have been little choice as to whether or not incision into the gland was employed. No cases of very troublesome hæmorrhage following incision were encountered. In every case, free drainage by tube or gauze wicks, or both, down to the affected gland was provided. Some irritation of the wound edges and surrounding skin, due to the digestive action of the escaping pancreatic secretion, was observed, but the free application of lanolin to the surface of the skin about the edges proved very efficacious in allaying the irritation. The drainage tract healed fairly promptly, as a rule.

Contrary to what one would naturally expect, following such an extensive destructive process as acute hæmorrhagic gangrenous pancreatitis, relatively few late ill effects therefrom have been observed. Perhaps the most surprising

fact is the relative infrequency with which diabetes mellitus has developed following wide destruction of pancreatic tissue. Slight transitory glycosuria has been reported fairly frequently in the acute stages, which, of course, means that the internal secretion is at first somewhat disturbed along with the external, but the tendency in either case is toward a gradual disappearance of the resulting unfavorable symptoms. A few cases, however, of persistent severe pancreatic dyspepsia have been reported as well as an occasional case of diabetes mellitus. Recurring attacks of acute pancreatitis are rare, although such have been reported. Perhaps the most common residual condition observed following acute pancreatitis is the chronic form, which, in turn, may give rise to certain well-recognized disturbances, discussion of which is beyond the bounds of this paper.

*Summary.*—(1) The chief pancreatic emergency requiring surgery is acute hæmorrhagic pancreatitis.

(2) It is primarily of chemical rather than of bacteriological origin.

(3) In view of the quite characteristic clinical picture presented, a correct pre-operative diagnosis should more often be made.

(4) Surgery offers the best chance for recovery, but even when early applied, the results leave much to be desired.

## BIBLIOGRAPHY

In order to avoid unnecessary repetition, anyone interested in the Bibliography of the subject is referred to the very full lists of recent contributions appended to the excellent articles by Speese: Nelson's Loose-Leaf Surgery, vol. v, and Archibald: Lewis's Practice of Surgery, vol. vii.

DISCUSSION.—DR. JOHN DOUGLAS (New York City) remarked upon what Doctor Finney had spoken of as acute pancreatitis but for which he had given reasons for having it called acute pancreatic necrosis. It is a condition of such rarity that one man very seldom has an opportunity to see a sufficient number of cases to form any definite conclusions. For this reason, during the last winter he had reviewed the cases which had occurred in St. Luke's Hospital during the past fifteen years. Curiously enough, the number was thirty-two, exactly the same number on which Doctor Finney reported.

In reviewing this group of cases, one is impressed very much by the extreme difference in the pathology which is described in the histories of the cases, and also by the difficulty in correlating the pathology in the pancreas with the pathological condition in the biliary system. Many of these cases divided themselves and presented three very distinct groups, although after looking them all over carefully it was very difficult to arrive at any definite conclusions.

In the first group, one was impressed by the large number of patients who gave a definite history of previous attacks. Usually these symptoms were diagnosed as severe biliary attacks or mild biliary colics, but in other cases where the pain was referred to the epigastrium it would be apparent that there was a real attack of pancreatic necrosis in some degree. In one case, where the patient died, the autopsy showed all the evidence of a previous attack.

One thing which was of particular interest in another group was the patients who had been operated on, and some operative procedure done either to the biliary system or drainage of the pancreas region instituted. These patients improved and were sent out either as not entirely healed or as cured. A very great percentage of these cases returned at various periods of two weeks to eight years with a subsequent attack of either pancreatic necrosis, from which they subsequently died, or were re-operated on and perhaps recovered, or with some type of pancreatic cyst.

That brings up the relationship of the etiology of the pancreatic cysts. I believe a large percentage of cases of pancreatic cysts are subsequent to an acute attack of pancreatic necrosis.

One patient at operation had a small amount of thickening in the pancreas, a moderate amount of fat necrosis, and nothing pathological in the biliary system. He was sewed up without being drained and within seventeen days he developed a cyst in his pancreas which when opened contained a quart of fluid. Another patient was operated on for acute pancreatic necrosis and subsequently had three attacks of pancreatic cyst, two years apart. In the first and third the cyst was drained and in the second attack the cyst subsequently subsided without operation. Another case came back three years after operation for acute pancreatic necrosis with a calcified area in the pancreas which was obviously a cyst.

The third group of cases was the most interesting of all. There was a considerable percentage of these cases operated on with a diagnosis of stone in the common duct, cholelithiasis or cholecystitis. At the time of operation for the gall-bladder lesion there was always some degree of pancreatic involvement. Very frequently nothing was noted but that the pancreas was hard and thickened and in some cases swollen to two or three times its normal size. In all of these cases there was fat necrosis present. In a very considerable number of cases notwithstanding the fact that the gall-bladder was drained, those patients went on and died and at autopsy there was a very marked hæmorrhagic necrotic disintegrated condition of the pancreas. That happened regardless of what we consider the proper treatment of pancreatic necrosis, the drainage of the biliary system being instituted, and demonstrates that the condition can progress and cause death. That leaves a question as to what we should do in regard to drainage of these cases, and in carrying out this same thought, if this method of biliary drainage is not the proper thing to do and is not effectual, then our treatment of acute pancreatic necrosis is wrong. But one case was particularly illuminating. Drainage of the gall-bladder had been done, and the patient improved until at the end of three weeks drainage stopped. The patient had another acute attack and by renewing the drainage she rapidly improved and recovered.

There were two cases reviewed which were not included in the series. They were cases of annular pancreas. In one case, which was operated on by Doctor Mathews, there was an obstruction of the duodenum. In the second case there were signs of chronic pancreatitis with the development of jaundice. That patient got well with the drainage of the common duct.

Dr. Carl Eggers (New York City) reported eleven cases of acute pancreatitis that had been under his care. One of them was diagnosed as probable cholelithiasis, one as resting between perforated ulcer and acute pancreatitis, and the other nine cases were diagnosed as probable pancreatitis, or secondary cyst.

In considering these cases with a view to reaching a diagnosis he had been impressed by the severity of the symptoms as compared with absence of physical signs.

Intense, often excruciating epigastric pain, associated with almost constant vomiting and slight fever, have been the outstanding symptoms. There is moderate leucocytosis. On examination one finds marked tenderness but practically no rigidity. These signs aid one in differentiating the condition from a perforated ulcer and cholecystitis. The former gives board-like rigidity and the latter has localized tenderness not extending across the upper abdomen as in pancreatitis.

Five of the patients succumbed to the condition, one without operation. Death seemed to be due to shock and the severity of the toxæmia in four cases, while the fifth was due to exhaustion, hæmorrhage, and perforation of the stomach after prolonged drainage of a secondary pancreatic cyst with necrosis of the gland.

The six patients who recovered were operated on. Drainage of the peripancreatic

tissue through the gastrocolic omentum was instituted. If the condition of the patient warranted it, one treated the associated gall-bladder disease at the same time.

Great interest attaches to the etiology of this condition, and although a great deal has been learned about its clinical manifestations and about associated lesions, we are still in doubt about the exact etiology. It seems in some way connected with biliary-tract disease, and accumulated evidence indicates that the process begins in the pancreatic-duct system and from there invades the parenchyma. It is probably not primarily an infection, but rather a chemical process. In all cases that he had operated on early, cultures were made of the peritoneal fluid, of the retroperitoneal exudate, and at times also of the gall-bladder. In every case the cultures were negative.

Dr. Max Ballin (Detroit, Mich.) mentioned a case demonstrating, he believed, a novel way of handling one of these pancreatic emergencies. A middle-aged woman had had fairly typical gall-stone colics for about two years. Two months before the operation to be described she had an acute attack which, no doubt, was a pancreatitis. Two months after this attack a tumor mass was felt in the upper part of the abdomen, smooth, fist size, in the epigastrium, mostly covered by the costal arches. Gall-stones with pancreatic cyst was the probable diagnosis. On operation there were found a gall-bladder with stones and, besides, a round, two-fist size tumor mass, seemingly belonging to the posterior wall of the stomach. In spite of the previous diagnosis of pancreatic cyst, at this time the impression of a benign tumor of the posterior gastric wall (myoma or something similar) prevailed. The stone-containing gall-bladder was removed first and further procedure as to the tumor decided upon. The tumor was adherent to the liver and the whole stomach was right over it so that the usual access through the gastrohepatic ligament could not be followed. Also the route through the gastrocolic ligament was not feasible for exposure of the mass. So, more for exploration as to the nature of the mass than anything else, a transgastric route was decided upon and the anterior wall of the stomach opened by a two-and-one-half-inch incision. The interior of the stomach was normal, the tumor did not originate in the posterior wall of the stomach but was adherent to it. Now we opened through this incision in the stomach also its posterior wall by a vertical incision and readily got to the tumor adherent broadly to the posterior wall of the stomach. It was so dense that it was still doubtful whether it was a soft tumor or a cyst. We tried to dissect it from the gastric wall on a chance of getting the tumor or cyst out. It soon broke and emptied about half a liter of brownish fluid with cholesterin crystals as from a hæmorrhage. Evidently it was a pancreatic cyst; also a large thumb-size pancreatic slough followed, as we have all seen before in pancreatitis. This drainage (slough and fluid) was obtained through the stomach without soiling the peritoneum and we decided to make the drainage permanent, suturing the incision in the cyst with interrupted catgut all around to the incision in the posterior gastric wall. The anterior gastric incision was closed by two rows of catgut and linen sutures.

This was done three months ago and it may be a little early to report on it, but so far the cyst has not refilled (X-ray check-up) and no untoward result has followed from the pancreatic secretion going through the stomach. If this transgastric method of draining a pancreatic cyst proves feasible in other cases it may be a way of overcoming the faults of the present methods of draining through the abdominal wall, namely, the irritation of the skin caused by pancreatic drainage and the necessity of keeping such drainage open, often for years, to avoid recurrence of the cyst.

Only one similar technic is mentioned in the literature in a case of a persisting pancreatic fistula of such a cyst drained through the abdominal wall and causing a great deal of discomfort by irritation of the skin. (J. Cathala and J. Seneque: Pancreatic Fistula Cured by Pancreaticogastrostomy. Presse Med., vol. xxxviii, p. 1534, November 12, 1930.) The authors implanted the whole fistulous tract into the stomach without ill results and with complete relief. Our patient gained twenty pounds and is apparently well at present, without indigestion.

# THE ACUTE GALL-BLADDER AS A SURGICAL EMERGENCY

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Until recently, the prevailing surgical opinion has certainly been opposed to prompt operation as a method of choice in dealing with acute lesions of the gall-bladder, and probably the prevailing opinion now is still so opposed. But this view is by no means unanimous. As long ago as 1923, Walton[1] urged the wisdom of early surgical interference, rather than delay, in handling acute gall-bladder disorders, and in the last few years other voices have been raised to the same purpose. The present writers share this minority view and this paper is intended to offer reasons for it. Before advancing such reasons, it may be well to present a brief summary of certain of the notable publications on the two sides of this question.

As representing German opinion of the date of 1923, Enderlen and Hotz[2] advocate postponement of operation until the interval and feel that early operation is indicated only by progressive changes for the worse. These authors advance statistics to show that the mortality of operation performed during the attack was double that performed during remissions. They operate if empyema is suspected and usually do a cholecystectomy. They give the impression that, in general, German surgeons prefer to wait in cases of acute disease of the gall-bladder. Lyons and Judd,[3] also in 1923, say that if the gall-bladder condition is acute, it is better to wait until the attack subsides before operating, and Judd and his associates renew the same statement in their article on the gall-bladder in Lewis's System of Surgery. Deaver,[4] in 1926, says that where possible, operation should be deferred until the acute attack subsides but that if conditions grow worse and interference is demanded, the acutely inflamed, gangrenous or perforated organ should be removed, if possible. Graham,[5] in 1928, expresses the view that it is seldom advisable to operate upon a patient with acute cholecystitis. He thinks that there is greatly increased danger of infection when operation is performed on an acutely inflamed gall-bladder and that it is particularly dangerous to remove the gall-bladder in the acute stage of cholecystitis. He further states that perforation of the gall-bladder occurs so rarely that one is justified in waiting for acute symptoms to subside in practically every case. Bruggeman,[6] in 1928, quotes Haggard, Archibald, Dean Lewis, McGuire and Richardson as favoring delay in acute gall-bladder cases, giving references to their publications in his own article, and concludes by saying that there is ample support for his position in thinking operation is rarely indicated in acute cholecystitis. It will be seen from this brief summary of a few noteworthy publications that there is a heavy battery of opinion opposed to prompt operation in acute gall-bladder disease.

The following references to literature, however, disclose the fact that there is substantial support for the opposite view. Walton,[1] in 1923, compared acute cholecystitis to acute appendicitis and advises immediate operation in all cases. In 1924, Bland-Sutton[7] felt that all cases should be operated upon immediately and that it was reprehensible not to remove the acute gall-bladder. Kirschner,[8] in 1924, advocated early operation because he believed that the patient was more willing to be operated upon during the attack and that the operation itself was easier, but he usually took one day for pre-operative preparation unless the patient was very ill. Crile[9] found in going over his gall-bladder statistics that he was impressed by the large percentage of

cures following cholecystectomy in acute cases. Leriche and Cotte, quoted by Bruggeman,[9] insist that cholecystitis be treated by immediate cholecystectomy, and Bruggeman[9] also says that French surgeons generally advise immediate operation. Miller[10] read a paper before this Society in 1930 reporting his personal experience and a series of unselected cases from the Massachusetts General Hospital. As a result of his investigations he felt that the general principle of operating on septic processes without undue delay held true for the gall-bladder and that severe pain was the best indication for prompt operation. Alexander[11] reported a number of cases which perforated while being watched and that out of twenty cases which had so perforated, there was a mortality of 50 per cent. He also favors early operation because of the dangers of delay. Mentzer,[12, 13] in two papers (one in 1930 and another in 1932), makes a strong plea for immediate surgical intervention. In the last of these articles he presents an extensive statistical study, the striking features of which are as follows. Eight cases of gall-bladder disease died while being treated medically. Of the cases treated surgically, thirty-one had advanced to perforation or gangrene while they were being watched and the mortality in the delayed operation cases of the acute type was 33 per cent., as compared to 19 per cent. in those operated on early in the disease. He earnestly insists that advanced acute cases cannot be recognized in many instances, even by the ablest physicians, and that, therefore, operative intervention should be undertaken early in every doubtful case. Nine out of twenty cases of ruptured gall-bladder had been kept in the hospital under observation for eleven days or more. Zinninger,[14] in 1932, also presented an elaborate study of statistics bearing on the subject under discussion. His findings indicate the great variation in the *pathological* changes discovered in patients presenting apparently the same condition *clinically* and serve to illustrate the difficulty in deciding which cases will subside under conservative treatment and which will become progressively worse. In cases operated upon less than forty-eight hours after onset, there was no mortality. In those operated upon in two to five days, there was a 6.6 per cent. mortality and in those operated upon after five days, the mortality was 25 per cent.—these cases, of course, all being acute cases. After analyzing his experience from different points of view, he concludes that in acute infections of the gall-bladder, operation should be immediately performed if the symptoms are severe and that this is particularly true if there is a high leucocyte count. To conclude this cursory survey of the literature, it may be pointed out that the volume of opinion in favor of prompt operation, as indicated by published articles, is growing steadily in the last few years and, finally, it may be interesting to know that at the Johns Hopkins Hospital Doctor Lewis,[15] Professor of Surgery, believes in the conservative handling of acute gall-bladder cases, whereas Doctor Finney[16] is a strong supporter of prompt operation.

It will be seen from the quotations presented that although there is wide diversity in opinions and statistics of results, nevertheless there is plenty of statistical support for the belief that better average percentages of recovery may be expected with early rather than delayed operation. We wish to approach the problem from a viewpoint other than the statistical, however. If it be sound principle to remove the inflamed appendix early, before other structures become involved, and if it be wise to operate promptly on perforated peptic ulcers to decrease the spread of infection, it seems logical to treat the acute lesions of the gall-bladder in the same way. It is true that there are certain differences, especially anatomical, in the usual relations of the appendix and of the gall-bladder. The gall-bladder on one side is buttressed by the liver and on the other is closely adjacent to the duodenum and omentum. When the gall-bladder becomes acutely inflamed, these two latter structures frequently become adherent to it and so tend to wall it off

from the general peritoneal cavity, reducing the chances of widespread infection should a leak take place in the gall-bladder. It is also true, however, that the appendix is by no means always an organ lying free in the open peritoneum. It is often retrocecal, retro-ileal or lateral, so that it is wholly or partially sequestered from the general abdominal cavity, but no one on that account advises delay in removal of an acutely inflamed appendix. It is likewise true that a leak in the duodenum or stomach may permit much more extensive and gross soiling than a leak in a distended gall-bladder, but any one who has realized the quantity of infectious material that a distended gall-bladder may contain will not be inclined to underestimate the possibilities of contamination that its rupture may entail. It is also true that the gall-bladder is a much more capacious and elastic structure than the appendix and hence less prone to early rupture or perforation or gangrene, but, nevertheless, such complications do occur in acute lesions of the gall-bladder also. In short, the same reasoning from a knowledge of pathological processes that deduces the wisdom of early operation in acute appendicitis and perforated peptic ulcer should lead to a similar course of action in acute gall-bladder disease, the only difference being that certain anatomical differences make the necessity for speed less urgent in the case of the gall-bladder. These differences, however, are differences of degree and not of principle. They do not justify a change from the plan of prompt operation before disease processes extend to other structures, to the plan of waiting for the subsidence of acute inflammation in order to perform an interval operation. In other words, one may say that acute appendicitis and acute perforated ulcers constitute emergency conditions of the first degree of urgency, whereas acute gall-bladder lesions are also emergency conditions but of the second degree of emergency. In support of this view, a few cases will be presented with brief comments.

Case I.—Mrs. J. B. One month following Cæsarean section this patient was seen as an emergency case with a mass in the upper right quadrant of the abdomen. There had been abdominal pain, tenderness, fever and chills over a period of eight or nine days during which time the obstetrician had searched most carefully for some cause connected with the Cæsarean operation as an explanation for the patient's illness. When seen by one of the writers, it was obvious that there was a large abdominal abscess in the upper right quadrant which was opened under local anæsthesia and a large amount of pus with several facetted gall-stones was evacuated. Patient recovered from the operation with a persistent biliary sinus and nine months later had the gall-bladder and the persistent sinus removed at a second operation.

*Comment.*—This case shows what may happen in deferred operations on the gall-bladder. It was also a case in which cholecystectomy seemed out of the question but it illustrates the possibility of a second operation being required where the gall-bladder cannot be removed at the first operation.

Case II.—J. M. T. F. Typical history of gall-bladder disease with a diagnosis of gall-stones and acute cholecystitis. The plan of waiting for an interval operation was adopted and the patient improved considerably after the first week or ten days. This improvement was of short duration, however, and a second flare-up took place which was again treated by the method of delay. Improvement did not occur, however, and after a total interval of twenty-three days, operation was performed by Dr. W. A. Fisher and acute cholecystitis with rupture of the gall-bladder was found.

*Comment.*—This case illustrates that even though transitory improvement may occur, the course of the disease does not necessarily go on to quiescence but that a second intensification may be even more severe than the first. There is little doubt that prompt operation in this instance would have prevented a rupture of the gall-bladder. In this case the gall-bladder was removed at operation.

CASE III.—W. P. Patient was admitted to the hospital with a diagnosis of acute gall-bladder disease and was kept on the medical service with the idea of operation after the acute symptoms had subsided. His condition, after fluctuating a little for two or three days, steadily grew worse and he was operated on six days after admission to the hospital for a gangrenous gall-bladder which had ruptured. The gall-bladder was removed at operation and the patient made a complete recovery.

*Comment.*—Although the waiting period in the hospital in this instance was much less than is frequently seen in institutions where the delayed plan of operation is in practice, nevertheless it was sufficient to permit most extensive and dangerous changes to take place in the gall-bladder.

CASE IV.—Mrs. McD. Patient was ill at home seven days with typical symptoms of acute gall-bladder disease and was brought to the hospital by her husband, who was a physician, because her symptoms were getting steadily and alarmingly worse. Operated on immediately. Acute cholecystitis with empyema of the gall-bladder was found. Because the patient's heart was regarded as in a doubtful condition from long-standing myocarditis, cholecystostomy alone was done. Patient recovered but had a persistent biliary fistula. Second operation four years later with removal of the gall-bladder.

*Comment.*—This case illustrates that emergency operation in badly infected gall-bladders, with a generally unsatisfactory condition of the patient, is not necessarily a fatal or highly dangerous procedure and it again illustrates the desirability of removal of the gall-bladder when it is feasible to do so.

CASE V.—Mrs. E. L. Patient was seen at her home with her family physician and acute gall-bladder disease of three days' duration was diagnosed and immediate operation advised. Patient was very reluctant to submit to operation and refused to accept the advice. The condition, however, grew steadily worse and five days later operation was performed and an acute empyema of the gall-bladder was drained. This patient recovered completely after a longer convalescence than would have been required had the gall-bladder been removed.

*Comment.*—In this case it was the patient's decision to defer operation that led to the delay, but instead of improvement taking place, the condition grew steadily worse and overcame, by its intensity, her reluctance to be operated on.

CASE VI.—A. K. Patient was admitted to the hospital with a clinical picture which was not entirely clear. Acute disease of the gall-bladder was considered the most probable diagnosis, but because of the uncertainty, it was decided to watch him for a time in the hopes of reaching more certain conclusions. Within two days his condition became speedily worse and it was then very evident that he did have acute gall-bladder disease. He was operated on promptly and a gangrenous gall-bladder, packed with numerous small stones, was removed. This patient made a complete recovery.

*Comment.*—In this instance the delay of two days was occasioned by uncertainty in the diagnosis. It serves to illustrate what rapid changes may take place in a gall-bladder that was not sufficiently typical to lead to an exact diagnosis.

CASE VII.—Mrs. H. B. McN. Patient had been ill at home for four days and was brought to the hospital with the signs of acute gall-bladder disease in intense form. She was operated on immediately. Acute cholecystitis was found and the gall-bladder removed. Complete recovery.

CASE VIII.—Mrs. W. D. Patient had been ill three days at home with typical symptoms of acute gall-bladder disease. She was brought to the hospital and operated upon immediately as an emergency. There was found an acute cholecystitis with perforation and small leak. Gall-bladder was removed and patient made a complete recovery.

CASE IX.—W. T. Patient was admitted to the hospital after nine hours of illness so intense, and with such a rigid upper abdomen, that a diagnosis of probable perforated ulcer was made. Immediate operation performed and an acute cholecystitis was found, with a stone impacted in the cystic duct. Gall-bladder was removed and the patient made an uneventful recovery.

*Comment.*—The last three cases are considered as illustrations of acute gall-bladder disease treated by immediate operation with removal of the gall-bladder and entirely satisfactory results. There have been many other such cases but these serve as ample illustrations.

Upon the basis of these cases we wish to make a comment on the sequence of pathological events. When the cystic duct is completely blocked and increasing tension develops within the gall-bladder, there can be no reasonable hope of a spontaneous recession of the process. The logical outcome is rupture with either a localized abscess or a general peritonitis—in other words, an extension of disease beyond the organ of its origin. Further, when pressure of a stone in the cystic duct, or of swelling and œdema from inflammation, or torsion of a gall-bladder with a mesentery leads to occlusion of the cystic artery, gangrene and not improvement will be the consequence of delay. There may be some more gifted diagnosticians than we who can foretell which cases will subside and which will become critically dangerous after several days. Such men can infallibly choose the cases that must be done early and let the others "cool off." Not only are we unable to make this distinction but we have no regrets about it. We think that those cases that are going to become worse clearly need early operation and we further think that those that might subside do just as well if operated on promptly. We think that by prompt operation there is a notable saving of time, pain, expense and danger as compared with the policy of delay.

From our experience we wish to draw another inference. Not only do we regard the acute gall-bladder lesion whether hydrops, empyema, torsion, gangrene or simple acute cholecystitis, as best treated by prompt operation, but again contrary to general opinion we believe that in most cases the operation should be a cholecystectomy. There may, of course, be instances where the patient's general condition requires the simplest and quickest surgical procedure—cholecystostomy—but in the large majority of cases the removal of the gall-bladder will not be too great a hazard. Furthermore, the worse the condition of the gall-bladder—badly infected or gangrenous—the more reason to attempt its removal if conditions permit. We have been gradually reaching this position during the past five or six years, and have been better satisfied with the results. During this time cholecystectomy has been carried out on a number of cases of all forms of acute gall-bladder disease without the loss of any of them. The series is too small to have any statistical value, hence we offer our views not as matters of proof but only as opinions with some backing of experience. Certainly there are obvious advantages in cholecystectomy. There is a prompt removal of a damaged, useless and infected structure. There is the avoidance of the not infrequent necessity of a secondary operation. Finally, there is a shorter, smoother, convalescence with all that goes with it—fewer dressings, less pain, less expense. In

regard to the matter of the type of operation, we are also convinced that if early attack is adopted as a principle, and delay in the hope of subsidence is abandoned, there will be fewer cases encountered at operation in which the surgeon will hesitate as to the removal of the gall-bladder. Not only will the local lesion be less formidable, but the patient will be less apt to have reached a critical general condition.

The arguments that seek to prove the advantages of interval operations are to us unconvincing. The most plausible of these arguments is that operation on gall-bladders in the stage of acute disease requires greater skill and judgment than operation on a quiescent gall-bladder and that many surgeons are not competent to meet these additional requirements. We would reply that standards of surgical treatment should be based on the course which offers the best results in competent hands. It is not sound policy to compromise principles of treatment to suit an assumed deficiency of skill in the profession. If a given plan of handling a surgical situation is conceived to be the best, it should be adhered to as the ideal. It then becomes a matter of each individual surgeon's conscience as to whether he or some other man is most capable of carrying the idea into practice. The objection, voiced by many, that early operation is more dangerous because of the chance of spreading infection, seems not to be borne out by our experience. Furthermore, as Miller[10] says, the general principle of prompt intervention in septic processes in the abdomen should apply as well to the gall-bladder.

To summarize, we are convinced that prompt surgical attack is the method of choice in all types of acute gall-bladder disease. This opinion is supported by the facts of pathology, by analogy with other acute abdominal conditions, and by actual experience as demonstrated in personal cases and by selected statistics. We further believe that in acute cases, cholecystectomy is the operation of choice and that only very special conditions should lead to its rejection.

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# TREATMENT OF ACUTE CHOLECYSTITIS

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The management of acute cholecystitis arouses more differences of opinion among surgeons than that of any other acute abdominal disease of like importance. In 1928, Bruggeman[1] presented a paper in which he made a careful review of surgical practice in the treatment of acute cholecystitis both from the literature and from personal communication. He found opinion divided in England, in favor of intervention without delay in France and in general conservative in Germany, although Kirschner[2] favors early intervention in acute cases after a day or two of observation. In this country the majority prefer to wait for the attack to subside unless the condition is urgent. Bruggeman himself felt that operation is very rarely indicated in the acute stage.

Most of the more recent American contributions have pointed out the dangers of delay and advocated prompt surgery in doubtful cases. Three years ago, Miller,[3] in a paper before this Association, advised early intervention if "there is a persistence of temperature, tenderness and spasm; and particularly, and most important, if there is severe pain, not easly controlled." H. F. Graham[4] reported a series of acute cases in which he found those operated on within forty-eight hours did better than those in whom there was a longer delay. In about 63 per cent. of Zinninger's[5] series the attack either failed to subside or became worse. He advocated early operation, but not immediate intervention as a routine. Mentzer[6] made the point that advanced acute cholecystitis cannot be recognized in many instances and therefore that operation should be undertaken earlier in case of doubt.

Mortality percentages after operation in acute cholecystitis as given by recent writers are Miller,[3] 13.5 per cent.; Whipple,[7] 13.7 per cent.; H. F. Graham,[4] 6 per cent.; and Zinninger,[5] 7.8 per cent.

I have been impressed with the favorable post-operative course of patients subjected to early cholecystectomy and have operated before the fever subsided in a majority of my own cases without feeling that an error of judgment had been made until rather recently, when an obese woman of fifty-two, who had had several attacks, succumbed two days following a partial cholecystectomy, with rapidly rising temperature and failing circulation. In order to throw light on the problem the biliary surgery on the ward patients for the past twelve years at St. Luke's Hospital, New York City, has been reviewed. As the point is to examine the treatment in acute inflammation of the gall-bladder and compare it with that in chronic inflammation and stone, cases of malignancy, stricture and multiple operations have been omitted from the tabulation, appendectomies excepted.

In this series there were 1,053 cases operated upon by twenty surgeons with a mortality of 6.7 per cent. For the purposes of this study the series is divided into:

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| Acute, | 107 cases with 10 deaths, | 9.3 per cent. mortality. |
| Subsided, | 94 cases with 5 deaths, | 5.3 per cent. mortality. |
| Chronic, | 754 cases with 24 deaths, | 3.3 per cent. mortality. |
| Duct stone, | 98 cases with 32 deaths, | 33. per cent. mortality. |

The duct-stone cases, whether acute or chronic, were separated because they represent a different as well as a more serious situation. The so-called chronic cases form a group which serve as a basis for comparison. Tabulation of a considerable proportion of this group shows that approximately 80 per cent. had stones and that 97 per cent. were subjected to cholecystectomy.

It is the remaining two groups, totaling 201 cases, which form the basis of this study. In order to make a comparison between active and subsided cases, a temperature of 100° F. was arbitrarily chosen as a dividing line. Those classified as acute were operated on with very few exceptions during the febrile stage according to this criterion. Of those rated as subsided about one-half entered hospital with fever, the remainder with the history and signs of an acute attack. They averaged three to four hospital days without fever before operation.

*Pathological Findings in Acute Cases.*—Of this group five patients, exclusive of those who formed abscesses, were found to have either perforation of the gall-bladder or bile in the peritoneal cavity without perforation being recognized. They were all urgent cases requiring prompt surgery. All occurred in the first three days of illness. Eleven patients had empyema of the gall-bladder, eight gangrenous cholecystitis on pathological examination and eleven an abscess outside the gall-bladder wall. Allowing for those in whom more than one of these conditions were reported there is a total of thirty-three patients, a little less than one-third of the group, who developed these more serious pathological findings. There were five deaths, one-half the fatalities, among them.

*Operation.*—Cholecystectomy was carried out in eighty-five patients and drainage in twenty-two. The latter comprised the more serious cases and the mortality consequently is considerably higher.

Removal of an acutely inflamed gall-bladder demands more experience and skill than cholecystectomy for chronic cholecystitis. Bleeding is likely to be troublesome. The distended and more or less rigid organ makes exposure difficult. Sometimes it is expedient to amputate through the neck rather than dissect out the cystic duct. On the other hand, in the earlier stages the œdematous organ, particularly if it is not already fibrous from repeated attacks, may be shelled out relatively easily. By the time the patient has cooled off, organization in the still red and thickened viscus may have progressed sufficiently to render dissection considerably more difficult.

*Mortality.*—A convincing reason for conservatism in acute cholecystitis is the experience of a fatality after early operation in a case which might have recovered if there had been less haste. In looking over the operative deaths in this series it is possible to pick out two or three in which the intervention or the type of operation done seemed ill-judged. On the other hand, reckoning from the onset of illness those operated upon within the first week showed a mortality of 7.8 per cent. as contrasted with 15 per cent. for the remainder. Zinninger's[5] figures also showed a lower death rate in the first week. Miller[3] found that the fatal cases averaged fifteen days from the onset of illness to operation while those who recovered averaged eight. (Table I.)

TABLE I

*Causes of Death in Acute Cases*

| | |
|---|---|
| Shock | 2 |
| Pulmonary embolism and thrombosis | 2 |
| Bronchopneumonia and cardiac failure | 1 |
| Myocarditis and bronchitis | 1 |
| Calculus pyonephrosis | 1 |
| Liver shock? (High temperature, early death) | 1 |
| Asthenia and progressive weakness | 1 |
| Septicæmia | 1 |

In considering the mortality I am impressed by the fact that fatalities were confined to older patients, the youngest being forty-seven, the average age fifty-nine. Peritonitis did not seem to be a contributing cause of death as frequently as one might expect. It is strongly suspected in two of the cases, one of whom died with a bacteræmia. Pneumonia likewise was not conspicuous. It was diagnosed as present at the time of operation in one patient drained under local anæsthesia. Six of the ten fatal cases had had previous attacks, a number of them shortly preceding the final illness.

The average post-operative hospital stay of the acute cases was twenty-one days, as opposed to nineteen in both the subsided and chronic groups.

*Follow-up.*—Of the seventy-nine patients leaving the hospital on whom cholecystectomy was done, there are follow-up examinations on seventy-one varying in time from two months to several years. In 83 per cent. the results were good or fair. Thirteen per cent., or nine individuals, had colic-like attacks at some time. These were usually not persistent but two came to a second operation in which stones were found in a remnant of the gall-bladder. Four per cent. developed incisional hernia.

Sixteen of the eighteen leaving hospital after drainage operations were followed up. Seven had a good result. One died two years later of cholæmia. Eight came to secondary cholecystectomy with two deaths.

*Subsided Group.*—In this group it is interesting to note that seven had empyema of the gall-bladder, four gangrenous cholecystitis according to the pathological report, three were described as having a perforation of the gall-bladder without abscess being mentioned and four an abscess alongside the

gall-bladder. One or more of these conditions were found in sixteen of ninety-four patients, a surprising proportion of serious pathological findings in those who had become or remained afebrile. Cholecystectomy was done in all but three patients, approximately the same proportion as in the chronic group. Occasionally, however, a portion of the neck was left. The five deaths were with one exception in individuals over fifty, the average age being fifty-seven. (Table II.)

TABLE II

*Causes of Death in Subsided Cases*

| | |
|---|---|
| Cardiac failure | 2 |
| Cerebral hæmorrhage | 1 |
| Pulmonary thrombosis | 1 |
| Liver shock? (High temperature, early death) | 1 |

There are follow-up records on sixty-eight of these patients subjected to cholecystectomy. Ninety per cent. had a good or fair result. Three had attacks of pain of whom two came to secondary operation. One of these had adhesions only, the other a stone in the common duct. This latter patient died. Three developed incisional hernia. One died at home two months after operation of unknown cause. Of the three who were drained one had a good result, one died after secondary cholecystectomy while the third is a recent case.

*Discussion.*—Those who advocate a waiting policy in acute cholecystitis point to the considerably higher mortality in operations done during the acute phase and the tendency of the attacks to subside without that danger of infecting the peritoneal cavity which is the rationale for emergency surgery in appendicitis. The mortality figures cannot be accepted at their face value for comparison because they include the fulminating cases and those who fail to resolve. Were it possible to select from the acute cases only those which might be considered operations of election, then a fairer basis of comparison would exist. This I have tried to do in the series reviewed but have found it unsatisfactory because the degree of urgency is not clear in so many of the records.

I am satisfied that immediate operations on patients with acute gall-bladder disease are unwise unless the evidence points to a free perforation. A period of observation not only allows for a more accurate grasp of the condition of the patient but for preliminary treatment.

The pathological findings already mentioned indicate how frequently an acute attack may go on to a serious condition. This, together with the high mortality in those cases which have failed to subside and come late to operation, serves to emphasize that the surgeon should be ready to intervene promptly if the progress of the case is not toward improvement.

Should one wait whenever possible for an acute case to subside? A number of the surgeons who have contributed to the series have not hesitated to operate early. There are many of these cases whose post-operative

course has been uneventful and short and who have been spared extra days of illness and expense as well as the possible development of a more serious condition. The fatality mentioned at the beginning of this paper serves, however, to emphasize the necessity of careful selection. A routine of indiscriminate early operation would, I suspect, increase the mortality. On the other hand, in younger patients, in good general condition, who have been under observation and preparation for a day or two, one may, it seems to me, intervene without waiting for the afebrile stage.

The general policy of those who treat the acute attack expectantly is to operate after some days of normal temperature. If the mortality figures are to serve as a criterion the question naturally arises as to whether the plan should not be carried to its logical conclusion and the patient sent away for complete resolution before removing the gall-bladder. It may be said against this suggestion that an appreciable percentage of the apparently subsided cases have pathological conditions, at times unsuspected, such as abscess, in which a relapse will occur. Several of the fatal cases in the acute group had had recent attacks. Of those cases coming to later cholecystectomy after drainage in this series the mortality has been high. After a serious acute attack one cannot expect as low a death rate as in the general run of cholecystectomies. In spite of these objections a longer interval before operation would seem to offer advantages in certain cases.

*Conclusion.*—Patients with acute cholecystitis should not be operated on immediately upon admission without an urgent indication. The surgeon should be ready to intervene promptly if progress is unfavorable. Younger patients in good condition after a day or two of preparation may be operated upon without waiting for the attack to subside. In poorer risks, if the course under observation is satisfactory it is wiser to allow the acute attack to cool off.

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# ACUTE CHOLECYSTIC DISEASE

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In acute and subacute cholecystitis, one of the outstanding features from a miscroscopical standpoint is the presence of œdema of the wall of the gall-bladder. The interstices of the tissue are filled with fluid. In acute cholecystitis the walls are also infiltrated with leucocytes. In subacute cholecystitis, there is a relative decrease of the proportion of polymorphonuclear neutrophils and replacement of them by lymphocytes and plasma-cells.

Often a condition is found which is designated as acute or subacute cholecystitis on a chronic cholecystitis. Such a diagnosis is made when, in addition to the other features, it is possible to demonstrate an excess of fibrous tissue in the walls of the gall-bladder. From a macroscopical standpoint, this excess fibrous tissue is usually denoted by unusual trabeculation.

Gangrenous cholecystitis occurs more often than was formerly thought. Gangrene may be mistaken for phlegmonous cholecystitis. In a few cases we have observed the gall-bladder completely separated from the surrounding attachments, so that it could be removed without dissection.

*Etiology.*—Continued studies seem to support the idea that cholecystitis is not always the result of infection. In some instances, using every known means, and following the most careful technic, it is not possible to find causative bacteria. It might be assumed that bacteria had been present in the tissues at some time, or that they had been present at the time of examination but had not been found. However, there is evidence that the changes observed are not always the result of bacterial invasion for similar lesions of the gall-bladder have been produced by introducing certain chemicals into the blood-stream of experimental animals. Furthermore, what part disturbances of metabolism play in the etiology of cholecystitis is not known. The significance of deposits of lipoid in the wall of the gall-bladder is not well understood. Possibly the deposits are the result of a simple physiological process, but their presence in cases in which there is clinical evidence of cholecystic disease makes one wonder what part they really play.

*Precedent and Opinion.*—Experience has added much to knowledge but apparently there is still a great deal to be learned before there will be an invariable set of clinical criteria that will establish the diagnosis and determine the immediate course to be pursued. Men of wide experience hold

opposing views: a well-known surgeon has stated that cholecystectomy during the acute stage of the disease entails unwarranted danger, but a surgeon of international repute has recommended immediate operation, with cholecystectomy as the objective.

Love, in the Hunterian Lecture given in 1929, said that until recently the trend had been to allow the acute inflammation to subside and then to perform cholecystectomy after remission of symptoms He reported that Hotz, in 1923, produced figures indicating that the mortality from operation during the acute attack is double that following surgical treatment after subsidence of symptoms. Pauchet, in 1926, subscribed to the opinion of the French schools, that if operation is indicated during an acute attack, drainage of the gall-bladder is preferable. The opinion expressed by Love was that there are two main objections to delayed treatment: First, the patient may, to his detriment, refuse subsequent operation. In Love's series of sixty-nine cases in which the acute condition was given time to subside, there were seventeen in which operation was not performed subsequently. The second objection is that there is a greater possibility of erroneous diagnosis, since perforated ulcer, acute intestinal obstruction, pancreatitis, and inflammation of a high-lying appendix may all be mistaken for acute cholecystitis. Love found that the mortality in all cases in which expectant treatment was given was 13 per cent., and that intervention was necessary in nine cases of fifty-two in which treatment was along expectant lines. In two cases general peritonitis occurred following gangrene of the gall-bladder. Love concluded that operation during an acute attack of cholecystitis carries a high mortality rate; in his series of cases it was 21 per cent. Furthermore, he stated that in most cases in which expectant treatment is given the condition will subside.

In Zinninger's study of eighty-nine cases of acute disease of the gall-bladder, thirty-five patients were operated on immediately after admission, and fifty-four were observed for from one to twelve days before operation. Of those who were kept under observation, the condition of only 37.7 per cent. was improved, and the gall-bladders of these were found subacutely or chronically inflamed at operation. No significant change in signs or symptoms was observed in 35.1 per cent. of the cases during the period of observation; uncomplicated acute cholecystitis and empyæma were the lesions most frequently found at operation. In a third group, composed of 27.7 per cent. of the entire series, the patients grew definitely worse during observation, and empyæma, gangrene, or rupture of the gall-bladder was found. The total number of cases in which symptoms and signs failed to subside was thirty-four (62.9 per cent.). Zinninger made considerable of the fact that the average total number of leucocytes in these cases was more than 15,000 in each cubic millimetre of blood. He wrote that in all cases of empyema it was more than 15,000. He also expressed the belief that the incidence of serious pathological lesions and the mortality rate rose with the duration of the attack and that, with early operation, the stay of the patients in hospital and the mortality rate were less. Zinninger recommended that in the presence of acute infections of the gall-bladder, immediate operation be performed if the symptoms are severe, and particularly if there is an associated high leucocyte count. He gave the opinion that early operation is indicated if the attack fails to subside promptly. In the cases which he studied, operation was performed between 1925 and 1930, and, I believe, by a number of different surgeons.

Graham reported on early operations for acute cholecystitis, and concluded that early operations give better results. He wrote that in a series of cases in which operation was delayed, many of the deaths could be attributed to the delay, longer and more difficult operations were necessary, and the number of post-operative complications and of days in hospital were increased.

Miller reported that if there is persistence of increased temperature, tenderness, and

spasm, and most important, if there is severe pain that is not easily controlled, surgical intervention should be undertaken without delay. He selected 200 cases in which operation was performed for acute cholecystitis. In the fatal cases, the average duration of symptoms from onset to operation was fifteen days, and in the cases in which the patients recovered, 8.2 days. He said that the reason for the long time between the onset of symptoms and operation was that the patients were sick at home before they came to the hospital. In any event, there is a striking difference between the two groups. In the fatal cases, palliative treatment had been given for an average of a week longer than in the cases in which the patients recovered.

*Symptoms May Be Masked or Inadequate.*—That it is not always possible to estimate the condition until the abdomen is opened is illustrated by the following experiences: In a recent article, Mentzer stated that in four instances perforation of the gall-bladder occurred while the patients were under observation and the condition was not recognized before death in any of the cases. In the course of a number of years we have encountered seven cases of acute cholecystitis in which general abdominal infection developed while the patients were under observation. In none of these cases were we able to recognize symptoms that would suggest disease of the gall-bladder, and it was not suspected that rupture of the viscus was the cause of the trouble until this was revealed at necropsy. In view of the results of our present study, we believe that in all cases in which there is acute abdominal distention and paresis from peritonitis, and in which there is no evidence of the source of the disturbance, the gall-bladder should be suspected of being the site of origin.

In addition to these seven unrecognized cases, we have found acute cholecystic disease present eighteen times at necropsy although the condition of the gall-bladder was not responsible for the death. In all of these the symptoms usually referable to disease of this viscus were either overshadowed or were not present.

*Results in 508 Cases of Acute Cholecystitis.*—In these 508 consecutive cases of acute cholecystitis in which we shall report the results of operation, 196 of the patients were males and 312 females. Of these patients, 248 had their first acute symptoms during the attack in which they consulted us, and in thirty-eight of these cases the attack marked the onset of symptoms. Two hundred and twenty-two patients had experienced previous spells of acute abdominal pain and digestive disturbance. Colicky pain and tenderness in the upper part of the abdomen were the outstanding complaints. Of the 508 patients, 332 had had pain of a colicky nature. In every instance the abdomen was tender. The records also revealed that in ninety-eight instances there was a palpable mass in the upper part of the abdomen.

The body temperature was elevated at the time of the examination in only 106 of our cases. In fifty-three, leucocytes numbered more than 15,000 in each cubic millimetre of blood. It was interesting to find that in 354 of the 508 cases leucocytes numbered between 5,000 and 10,000, in four less than 5,000. In other words, in the majority of instances, the leucocyte count was within normal limits and entirely out of proportion to the severity and extent

of the existing infection in the biliary tract. This may tend to support the idea that infection is not responsible for the condition of the gall-bladder in many of these cases.

Stones were present in the gall-bladder in 484 cases. Forty-three of the patients also had calculi in the common bile-duct.

The pathological changes in acute appendicitis have been compared with those of acute cholecystitis, and it has been found that generalized infection of the peritoneum is a much less common complication with inflammation of the gall-bladder. When the gall-bladder becomes inflamed, it is rapidly shut off by adhesions, so that perforation of the viscus into the general peritoneal cavity is an uncommon event. Turgidity may be confused with distention. The walls of œdematous gall-bladders which are the site of acute disease are often one-half inch (1.27 centimetres) or more thick. It is easy to imagine at operation that the gall-bladder is on the point of bursting, and that the operative procedure has fortunately just averted this calamity. Perforation is probably due, in all cases, to local gangrene of the wall of the viscus, although popular opinion pictures the gall-bladder as bursting like an over-blown balloon. In sixty-eight cases of our series, the wall of the gall-bladder was gangrenous. It had perforated in sixty-one cases, with formation of an abscess about the viscus in thirty-eight. In three cases it ruptured into the general peritoneal cavity and general peritonitis ensued. The disease of the gall-bladder was responsible for the formation of a cholecystoduodenal fistula in six cases; in one case there was a cholecystocolonic fistula. That the infection was not only acute, but also was extensive, is shown by the fact that definite involvement of the pancreas was recorded in eighty-one of the 508 cases, and this figure probably does not adequately express the frequency of such a situation.

Cholecystectomy or the removal of all of the gall-bladder except the portion embedded in the liver was performed on 419 of our patients. Eighty-nine underwent cholecystostomy. It was found necessary to open the common bile-duct and to establish drainage of the biliary tract in seventy-two of the cases, in addition to the procedure referable to the gall-bladder itself. There were nineteen deaths following cholecystectomy and five following cholecystostomy.

*The Time for Operation in Cases of Acute Cholecystitis.*—A review of the literature shows that there is considerable difference of opinion regarding the time for surgical treatment in cases of acute cholecystic disease, and regarding the question of whether it is ever permissible to consider an emergency procedure. In fourteen of our cases, the operation was performed as an emergency measure. One of the patients died. In this instance, cholecystectomy was performed for acute gangrenous cholecystitis with stones. Death resulted from general peritonitis and terminal bronchopneumonia.

We shall probably not be able to settle the question of when to operate in the acute cases, but the present tendency is to carry out surgical treatment

early in cases of acute cholecystic disease. Apparently there is not the same fear of operating in these cases as there formerly was. We are inclined to think that this is due to recognition of the fact that infection is not always the cause of the condition and that these patients can have the necessary surgical treatment with comparative safety. In these acute cases, the operation usually should be removal of the gall-bladder. Our study of this group of 508 surgical patients would seem to bear out these conclusions although the operations were performed by several surgeons, among whom there were bound to be differences of opinion.

Although we wish to subscribe to the plan of early operation in acute cholecystic disease, and although this coincides with the opinion expressed in the more recent literature on the subject, nevertheless we feel that there are certain instances in which surgical treatment should be postponed. In some cases it should be delayed for a long time. In caring for these patients it will be necessary to consider each one as presenting an individual problem. There is no set plan that will fit all cases. The following illustrates the type of case in which we believe operation should be postponed:

A man, aged fifty-six years, registered at the clinic October 26, 1932. He had had attacks of severe epigastric pain over a period of seven months, but the last attack had occurred seven months previous to the time when he came for consultation. Vomiting had accompanied the attack.

On examination, his temperature, pulse rate and leucocyte count were normal. While röntgenological examinations of his biliary tract were being carried out he had a more severe reaction than usual. There was epigastric tenderness and rigidity. At the first examination after the röntgenological investigations, leucocytes numbered 10,300 in each cubic millimetre of blood, the temperature was 98.2° F., and the pulse rate seventy beats each minute. The next day the patient was definitely having one of his attacks and for a month afterward his temperature ranged from 100° to 105° F. The number of leucocytes varied from 15,000 to 22,000 in each cubic millimetre of blood. There was marked tenderness in the left upper abdominal quadrant, distention, and a palpable epigastric mass. At the height of the attack, the value for bilirubin was 2.1 milligrams in each 100 cubic centimetres of serum. After this pneumonia developed and the patient seemed altogether too sick to be operated on. Finally infection from gas bacilli developed in the left buttock. After the man had passed through all of this difficulty, and had been in the hospital for six weeks, it was decided that the best plan would be to proceed with the operation.

At the time of the operation, both subphrenic spaces were examined for fear that infection might be present there, but these spaces were normal. So far as could be determined there was no abscess anywhere. There were many adhesions around the gall-bladder, but no sign of general peritonitis. The gall-bladder was opened, and stones and pus were removed. Three days after operation the patient's temperature was normal and remained normal. The man has made a very satisfactory recovery.

Whether the attack was precipitated by the röntgenological examinations is difficult to determine. It is known that in some cases of disease of the gall-bladder an attack is precipitated in this way, but we never have seen one as severe as this. We are inclined to think that if operation had been performed early the patient would not have survived the operation.

*The Type of Operation.*—Cholecystectomy will not be permissible in

every case, but this procedure should be carried out whenever feasible. This conclusion has been reached after watching the patients during their immediate convalescence and evaluating the ultimate results. It has been our experience that leaving the acutely inflamed gall-bladder *in situ* may result in continued drainage, pancreatic fistula, and then, after a number of weeks, death of the patient probably due to continued absorption. The thick-walled gall-bladder in an acute state can be removed as readily as one that has reached the chronic stage, and it seems that there is a definite advantage in removing this infected tissue.

No one would feel that a deeply situated, inaccessible, acutely inflamed gall-bladder should be removed from an extremely sick person. Cholecystostomy may be all that is warranted. However, some of these patients will have fistulæ which will persist until cholecystectomy is performed. In other instances, the gall-bladder undoubtedly shrivels and is eventually almost entirely destroyed by the inflammatory process. If cholecystectomy is finally performed in this type of case, every effort should be made not to traumatize the surface of the liver. To avoid this, a sufficient amount of the fibrous wall of the gall-bladder should be left on the surface of the liver to prevent extension of the disease into the hepatic substance.

Ordinarily the common bile-duct should not be opened during operation for acute infection in the gall-bladder. Usually it is inaccessible. There may be a great deal of œdema of the adjacent structures, making it difficult to recognize the duct. In most instances the disturbance is confined to the gall-bladder, and the condition is not complicated by the presence of stones in the common bile-duct. If the clinical history suggests the presence of a stone in the duct, or if a calculus can be felt in it, then an attempt should be made to clear that situation.

*Summary and Conclusions.*—In many cases infection is undoubtedly the principal factor in the changes observed in the gall-bladder and biliary tract. In other instances in which there is no detectable infection, however, the reaction in the tissues seems identical. Experimental studies seem to indicate that this may be the result of some alteration in the chemical reactions of the body. With changes in metabolism, lipoids may be deposited in the wall of the gall-bladder. Future investigations may prove that this phenomenon plays an important part in the disturbances occurring in the biliary tract.

Cholecystectomy is preferable to cholecystostomy in all cases in which the condition of the patient will permit carrying out the operation without unwarranted risk. In a small proportion of the cases cholecystostomy will be indicated.

The results obtained in our series of cases seem to justify the plan of operating early in cases of acute cholecystic disease.

Discussion.—Dr. Fred B. Lund (Boston, Mass.) said some years ago surgeons always waited for gall-bladders to quiet down, thinking that they got the best results in

that way. In recent years he had come to Doctor Stone's conclusion, that is, the gall-bladder is as much an emergency as an appendix except that one does not have to operate on it in the middle of the night as in peritonitis from appendicitis. He had been called in the evening to see a fat woman with a very distended gall-bladder and acute symptoms, and arranged to operate in the morning. By morning the tumor had entirely disappeared; she had a general peritonitis and the gall-stones were spread around the peritoneal cavity. In some occasional cases it is not wise to wait even a short time. Operations in subacute cases where the gall-bladder is thick do just as well as in the chronic cases and occasionally cases that one thinks are subacute are really acute because the cystic duct is plugged and there is pus in the gall-bladder in spite of a normal temperature and very, very slight tenderness.

When he had waited for gall-bladders to quiet down, he had sometimes been disappointed, because they gradually got worse. While they were supposed to be quieting down fat necrosis was extending into the pancreas from the gall-bladder. So, everything considered, while not as urgent as appendicitis, the sooner an acute bladder is operated on the better. The more acute it is the more important it is to operate because those patients with very severe pain and high temperature are the ones in the greatest danger of perforating. They also welcome the operation at this time.

In cases where the cholecystectomy is technically too difficult one may have to do a cholecystostomy, but at any rate they have been saved from a very severe danger

Dr. Richard H. Miller (Boston, Mass.) said that Doctor Stone, Doctor Smith and Doctor Judd each had mentioned a paper which he presented before this organization in 1929. What led Doctor Miller to do that was two very unusual instances of acute distention of the gall-bladder due to blocking of the outlet by stones. Each of those cases was one in which there was no infection. There was no previous inflammatory thickening, nor were there any adhesions. In one instance the gall-bladder swelled very rapidly, causing excruciating pain, followed by perforation. In this case the patient died. The second case, which was similar, underwent operation just as perforation was about to occur, and he recovered.

Doctor Miller was thereupon led to look up the cases of acute cholecystitis, so-called, at the Massachusetts General Hospital. He found the results were as Doctor Stone had already mentioned, namely, that in those in which more procrastination had taken place there was higher mortality, whereas in those instances in which operation was performed early the mortality was less.

He felt now, after having observed similar instances for several more years, more or less as he said at that time, that one cannot lay down a hard-and-fast rule. Each case has to be judged on its own merits. If a patient comes in with an excruciatingly acute attack, the pain of which is controlled with difficulty, and a swollen gall-bladder, one can presume sudden distention, possible early perforation, and operation should be done immediately. If the patient shows more signs of sepsis and does not seem quite so sick, one is justified in waiting for twenty-four hours to bring the body fluids up to normal and do the operation under better conditions. In those people in whom the attack is not so severe, where perhaps it presents certain evidence of subsiding, then one can, without any particular danger, wait until the process has entirely subsided.

Dr. John Homans (Boston, Mass.) supported the contention that the gall-bladder of acute cholecystitis almost necessarily becomes in some degree necrotic by calling attention to what he first heard some years ago from a pathologist in New York who maintained that the disease was caused by the impaction of a stone in the ampulla of the gall-bladder in such a situation as to interfere with the blood supply of the whole organ. Pressure of the stone, by cutting off the venous return, first causes an acute passive congestion. That fits in with the violent œdema and with the dark redness of many of these gall-bladders. Possibly arterial ischæmia occurs later, but in any case necrosis of some part of the gall-bladder's wall is common.

Doctor Judd, in his first slide, showed a gall-bladder with a great indentation in the ampulla where the obstructing stone had been fitted. Such an appearance is typical. The vessels supplying the organ usually pass over the bulge made by the stone and are compressed at that point. Obstruction of the cystic duct itself probably acts in a different manner and does not necessarily lead to acute cholecystitis.

As for the part played by infection, though that is doubtless considerable, it must be admitted that if gangrene were due primarily to bacterial rather than to circulatory causes, acute cholecystitis would be an even more dangerous disease than it is, and operation would spread, rather than restrain, infection. Whereas, actually, as Doctor Stone and others have pointed out, early operation, at what might seem to be a most violent stage of infection, is followed by rapid healing.

Dr. Hubert A. Royster (Raleigh, N. C.) said that twenty years ago, in one year he saw two patients die of ruptured gall-bladder, one in the convalescence of typhoid fever and the other one without any previous history. Ten years ago he wrote some notes down with the following heading, "Shall We Operate Upon the Acutely Inflamed Gall-Bladder?" but he never had nerve enough to bring it out until three years ago when he heard Dr. R. H. Miller speak before the Association.

While he did not believe that the analogy between the gall-bladder and the appendix is a complete one, there is enough kinship to make one feel that, as expressed by others here, we are not to jump on the patient in the middle of the night. As a matter of fact, we seldom do that with appendicitis now. But, they lead us to understand that the acutely inflamed gall-bladder represents a partial analogy and sometimes a very definite one.

The feature which concerned him also was the very simple and easy methods by which the gall-bladder can be removed in the so-called subacute stage, that is, within a day or two of the beginning of the attack, after there has been a beginning or complete subsidence of the symptoms.

When a gall-bladder is attacked at that period, it can be peeled out very much as if you were peeling a banana and the access to the ducts is perfectly easy unless there have been many previous attacks. Therefore, we are not waiting in such a case for the firm, dense, hard adhesions which we allow to come in such cases as this.

The only thing to think back upon is this, in the old days the surgeon attacked acute appendicitis after he had waited for the abscess to form. Is it any more reasonable to wait in the case of the acute gall-bladder until jaundice has appeared?

Dr. Harvey B. Stone (Baltimore, Md.) said that he had expected to hear a great deal of adverse comment and thought he would have to defend his position, perhaps at a disadvantage. As far as he recalled none of the gentlemen who had spoken had taken any essential issue with the stand which he made.

He said there were, however, one or two things that were brought out in the papers of Doctor Smith and Doctor Judd, and certain things in his own paper which he did not have the time to bring forth, that he should like to emphasize.

One of them was the fact that many of the cases in which waiting fails to give good results are the most difficult of all. Doctor Smith pointed out in his paper that the cases in which subsidence fails to take place are the most difficult operations. They believe that if such cases were operated upon early the performance of the operation would be very much easier.

Another thing that he would like to say is that in reading over the literature in the days when nearly every voice was against early operation, there was a widespread emphasis upon the danger of spreading infection by operation upon the acute gall-bladder. Doctor Judd has shown infection perhaps is a secondary factor in the pathological condition that exists in most instances. As other speakers to the subject have pointed out, and as they mention in their papers, in most instances the acute and rapid change in

the tissues is due to obstructive rather than to infectious factors, either the impaction of a stone in the duct with the accumulation of secretion behind, or pressure upon the cystic vessels and interference with the blood supply.

In other words, there is here an analogy between the gall-bladder and the appendix, as brought out by Wilkie, who has emphasized over and over again that the dangerous cases of appendicitis are the obstructive rather than the infectious cases. As to their position in this matter, in agreement with everybody else, they realize that there are cases in which it would be folly to operate immediately, but they do feel that as a principle, as a general plan of attack, it is very much wiser from every standpoint to regard the acute gall-bladder as a condition to be relieved promptly rather than as a condition to be waited upon for a period of subsidence or cooling off.

Dr. John M. T. Finney (Baltimore, Md.) recalled the development of biliary surgery. It was with great trepidation that the abdomen was opened and the gall-bladder exposed and stitched to the parietal peritoneum. Then, after waiting for a few days, a small opening was made in the gall-bladder and it was let drain, without attempting to remove the gall-stones. Then some bold soul began removing the gall-stones, and so cholecystostomy was established. Now we have reached another stage in the development of biliary surgery.

The question now is, shall we treat these cases as emergencies, like appendicitis, and take the gall-bladder out as soon as the diagnosis is made, or even when it is only suspected, as is done in the case of appendicitis, or are we going to run the risk of a perforation of the gall-bladder just as with the appendix? While the two conditions are not strictly analogous, there is great similarity between them.

Personally, due to a gradual process of evolution, he now takes a stand firmly in favor of treating the gall-bladder just as he does the appendix, that is, taking it out as soon as he is reasonably sure that it has any serious trouble the matter with it.

This may seem to some a rather advanced position, but it seems perfectly logical when one listens to such arguments as have been presented this afternoon. While there is something to be said on both sides of the question, the weight of the argument is in favor of the more radical procedure. However, one cannot be absolutely dogmatic in any surgical question—or hardly any—and this is no exception. One should always exercise surgical judgment and be guided by it.

# ACUTE UROLOGICAL EMERGENCIES, PAST AND PRESENT

By Edwin Beer, M.D.
of New York, N. Y.

During the last twenty-five years, owing to the rapid development of cystoscopical diagnosis and therapy, together with the perfection of radiography, many so-called emergencies of the past have been converted from operative surgical emergencies into much less urgent conditions. In the urinary tract, urological emergencies, outside of those caused by trauma, are due to (1) obstruction; (2) infection; and (3) spontaneous hæmorrhage.

*Obstruction in the upper urinary tract* due to intrinsic conditions, such as stone, tumor or stricture in the ureter, in the absence of infection rarely calls for an urgent operation, as most of these obstructive conditions can be relieved by the passage of a ureteral catheter, which takes care of the immediate emergency. For obstructions which are extrinsic, due to inflammatory conditions about the ureter or compression of the ureter, relief by ureter catheter may not be so readily given, and these may at times require immediate operative interference. If the condition is bilateral, whether due to intrinsic or extrinsic cause, and cannot be relieved by passage of ureteral catheters, an urgent surgical operation to relieve the obstruction or to drain the kidney so as to save the patient's life is usually indicated. If infection is superadded to unilateral obstruction, and the ureteral catheters cannot pass the obstruction, a grave emergency arises, and the obstruction must be relieved at once or a nephrostomy be performed. The latter will be necessary only in those cases where the obstruction cannot be readily reached and relieved. Furthermore, bilateral obstruction in the upper urinary tract with superadded infection under the same circumstances, that is, inability to pass the obstruction with a ureteral catheter, leads to a most urgent condition, and the side on which the most recent attack of pain or discomfort has been experienced should be exposed and the kidney drained.

*In infections of the kidney,* the so-called blood infections, usually due to staphylococci or streptococci, a real surgical emergency at times presents itself. In the absence of obstruction to the outflow of urine from the kidney, these cases can produce symptoms of sepsis and simulate at times, especially if the abscesses are on the anterior surface of the kidney, serious intra-abdominal or intraperitoneal pathology, such as perforated gastric ulcer, acute cholecystitis or acute appendicitis. Only a short time ago, this type of so-called hematogenous kidney infection was regularly operated on and a nephrectomy performed. During recent years, we have become much more conservative and when the diagnosis has been definitely established, it has usually been possible, in the absence of obstruction, to save the kidney by a decapsulation, with or without multiple incisions of the suppurating foci in

the cortex of the kidney. At times, the diagnosis of this condition is very difficult. In the absence of urinary changes, absence of positive stone shadow and ureteral obstruction, and in the recognition of curvature of the spine to the opposite side, as well as obliteration of the lateral margins of the psoas muscle on the side of the abscess, associated with local exquisite tenderness or shock tenderness, one is justified in exposing the kidney and attempting to save the same, even in the presence of a positive blood culture. The wound is usually left wide open after the decapsulation, and a rubber dam placed in front and behind the kidney. If the patient does not improve rapidly, which is the usual course of events, a secondary rapid nephrectomy is readily executed, as the kidney lies free in the bottom of the wound.

As opposed to the infections by the cocci, bacillary renal infections, even when associated with bacteræmia, are much less serious conditions as a rule and rarely require operative interference such as decapsulation and incision of cortical foci. Some of these severe infections may well be a combination of cocci and bacillary invasion. In the so-called pyelitis of late pregnancy, ureteral indwelling catheter may suffice to tide over the worst cases; usually surgical interference of any sort is not required.

Closely related to these types of infection are those rare cases of infarcted kidney, usually associated with some cardiac disease, in which the main artery to the kidney is blocked. This may produce a picture of profound shock and even if the embolus is aseptic, if the main branch of the renal artery is blocked, an urgent nephrectomy may become necessary. The diagnosis of this condition is particularly difficult, but the absence of all secretion from the catheterized ureter would suggest such a pathology.

*Spontaneous hæmorrhage.*—This type of severe hæmorrhage occurs in the upper urinary tract in tuberculosis of the kidney, tumors of the kidney and its pelvis and in such rare conditions as peri-arteritis nodosa and those cases grouped as essential hematurias. Occasionally, though rarely, such hæmorrhages may be very profound, so that the surgeon may be forced to do an urgent nephrectomy, after cystoscopical examination has shown that the other kidney is secreting normally. Usually, however, with transfusion and irrigation of the bleeding side with various antiseptics, as well as adrenalin, the bleeding can be controlled, especially if transfusion has been given. In recent years, nephrectomy for such acute hæmorrhage, as an emergency operation, has not been necessary.

In the lower urinary tract, obstructions, infections and hæmorrhages also may lead to acute emergencies, which are usually relieved by simple measures, such as the passage of a catheter, and by leaving the catheter as indwelling. In impassable obstructions with retention, an urgent bladder puncture or some type of cystotomy is demanded. Hæmorrhages are usually controlled, as well as infections, if the latter is still within the lower urinary tract, by non-operative, instrumental measures, such as evacuation of clots, irrigations with hot solutions, and the use of indwelling catheter. Rarely in uncontrollable bladder bleeding, a cystotomy and firm packing of the viscus are essential.

If, however, the infection has spread and led to a perivesical, peri-urethral, prostatic or periprostatic abscess, or extravasation, such conditions may require urgent interference to save the patient's life and prevent further destruction of the tissues of the perivesical or pre-vesical space.

When we consider the traumatic conditions which may lead to urgent surgical interference, we must bear in mind that the trauma may be from within, that is, due to some pathological condition which the patient is carrying, such as calculi, or it may be caused by forces from without, whether instrumental or in the nature of contusion, *etc.*, to the body. In some rare conditions, especially when there is disease in the upper urinary tract, as in hydronephrosis, polycystic kidneys and the like, an obstruction of a ureter by passage of a calculus may lead to a rupture of an infected hydronephrosis or an infected polycystic kidney. As a result of the rupture, an acute surgical condition develops, which has to be met by an urgent drainage operation. Such spontaneous ruptures, due to stones passing down the ureter, are unusual, but in a large clinical experience, every once in a while one encounters such a condition, which demands immediate surgical interference. The recognition of the exact type of pathology and complications which have developed which make the operation urgent may be far from simple, but with the use of excretory urography every once in a while, one is able to visualize the exact condition, provided the kidney function is adequate. Retrograde pyelography with one of the iodine contrast substances, preferably skiodan or uroselectan, will also help clarify the exact pathology, so that one is not compelled to make a long search after opening the patient to determine the diagnosis and exactly what one must do. With the diagnosis made pre-operatively, the emergency operation is carried out expeditiously and intelligently with a thorough meeting of all the indications.

So far as injury from without is concerned, excluding instrumental injury, which is less and less frequently seen in the upper urinary tract as a result of impaction of the ribs against the more or less distended kidney, the latter is liable to be ruptured and torn. The tears usually radiate from the pelvis into the cortex, and if the blow is a moderately severe one and the kidney has not been the seat of a pathological change, hydronephrosis, polycystic kidney or tumor, the chances are that the bleeding which follows the trauma will gradually cease and no operation will be necessary. If, on the other hand, the blow has been a more severe one, and the bleeding continues, the anæmia becomes more pronounced and the blood-pressure drops, despite intravenous glucose, as well as blood transfusion, one may be forced to do an exploratory operation which may lead to a nephrectomy or a partial nephrectomy or a reconstruction operation on the torn organ.

If, on the other hand, the kidney has been the seat of such conditions as were just mentioned, it will usually be necessary to remove the kidney. Such an operation is usually not immediately indicated, as the patient is in shock and has to be brought out of shock and treated expectantly. It rarely is an emergency in the sense that the acute gastric perforation or duodenal

perforation is an emergency. When the decision is reached that the bleeding is uncontrollable, such a case demands an expeditious procedure.

Trauma to the ureter itself, tearing of same, is rarely seen, except in extensive fractures of the pelvis and these cases, just as many of the kidney cases, usually have associated intraperitoneal injuries such as splenic, hepatic or intestinal ruptures.

Rupture of the bladder, due to trauma from without, is a much more common accident since automobiling has become popular. Patients under the influence of alcohol, with their bladders full of urine, are particularly prone to this very serious accident. These ruptures, as is well know, may be extraperitoneal or intraperitoneal, and in the future may be recognized more readily with the use of intravenous or excretory urography, which will show the iodine solution either in the perivesical space or intraperitoneally. As yet, only a few pictures of this type of damage have been published (with excretory urograms). Another aid in diagnosing rupture of the bladder is by passing a catheter, obtaining blood, and then injecting sterile $CO_2$ through the catheter. If the perforation is intraperitoneal, the $CO_2$ will rise under the diaphragm and be easily seen on a film or fluoroscopically, or if the patient is placed in the lateral position, it will be seen on the uppermost side under the parietes of the abdominal wall. If, on the other hand, the perforation is extraperitoneal, the $CO_2$ will collect in the perivesical tissues running up towards the navel. Cystoscopical determination of a rupture of a bladder or filling of a bladder and trying to recover the same amount of fluid as has been introduced are not to be recommended, and are not reliable, as one can, despite the fact that there is a fair-sized opening in the bladder, cystoscope the patient and not see the tear or opening, and one may recover the introduced fluid at times with perfect ease.

The local signs of irritation, peritoneal or perivesical, together with blood in the urine after severe injury, especially if one is fortunate enough to get an excretory urogram showing extravasation of iodide in the perivesical space or in the peritoneal cavity, creates a real surgical emergency, which should be immediately met with suprapubic drainage and wide drainage of the perivesical space after suture of the intraperitoneal or extraperitoneal tear. If the bladder has been torn from the urethra, an indwelling catheter should be left in while suprapubic drainage is also carried out. If bones have been broken in the pubic region, this area should be protected with rubber dam, so that necrosis of the bone is minimized.

Trauma to the urethra in the penile portion is less common and less serious than in the deep urethra, where the injury is frequently produced by falling astride a hard object or by a severe and serious blow to the pelvis. In these cases, if the urethra is blocked to the passage of an instrument, and it has not been the seat of a previous contracture, immediate perineal section is indicated with intubation of the urethra by an indwelling catheter and the urethral ends approximated after débriding the lacerated urethal tissues.

Extensive incisions in the perineum and adjacent parts must be made to relieve extravasation, especially when complicated by infection.

In view of the fact that in many of these cases of injury from without the previous condition of the urinary tract is not known, and in view of the fact that the injury may be in the nature of serious contusive force, all these patients should be given the benefit of tetanus antitoxin and gas-bacillus antitoxin, after testing out the sensitivity in the conjunctiva.

If we look back over these various groups of cases, it becomes evident that in the traumatic cases, the modern developments in urology have helped clarify the diagnosis, so that the surgeon in emergency may act with more intelligence than twenty-odd years ago; and when we consider the non-traumatic cases, it becomes more clear that the large group of cases which used to be considered emergency surgical procedures have, due to the advances in urological surgery, become amenable to instrumental, rather than cutting, procedures.

# ACUTE OBSTRUCTING AND INFLAMMATORY LESIONS OF THE KIDNEYS AND THE URETERS

By Waltman Walters, M.D.

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Emergency operations on the kidneys and ureters are usually performed because of obstructing lesions interfering with the adequate passage of urine. Symptoms of localized or generalized infection may occur because of pyelovenous backflow, the result of overdistention of the renal pelvis, or absorption of toxins or bacteria from severe cortical infection, especially abscess. In these cases the relief of the obstruction, either by direct removal of the obstructing lesion, or removal of the accumulation of urine above the obstruction, is absolutely necessary. Delay in carrying out such procedures may mean the loss of the kidney and possibly the patient. If the infection in the kidney is severe and associated with bacteræmia or septicæmia, nephrectomy is necessary immediately.

*Hydronephrosis.*—If the obstruction of the upper portion of the urinary tract is intermittent and incomplete, hydronephrosis results frequently without symptoms of a systemic infection. For example, in the case of a young woman recently operated on, hydronephrosis had appeared subsequent to injury of the right ureter during operation for the removal of what was reported to be an extensive malignant lesion of the right ovary. The resulting urinary fistula persisted for four months, and a year later the right kidney became enlarged and painful. Apparently it did not increase in size during the succeeding twelve months. When nephrectomy was performed, 95 per cent. of the renal parenchyma had been destroyed, and when the kidney was emptied of approximately 400 to 500 cc. of infected urine, its shell weighed only fifty-five grams. In all probability, the obstruction to the right ureter was incomplete.

In contrast to the foregoing is the course of events in the presence of complete obstruction, but for a period insufficient to produce destruction of the renal parenchyma, yet long enough for the renal pelvis to become markedly dilated. Temporary nephrostomy performed under local anæsthesia will relieve the obstruction and the stones can be removed later. In such a case, even though from 200 to 300 cubic centimetres of purulent white urine drained from the kidney immediately, study of renal function by intravenous urography twenty-eight days later gave evidence of but little residual dilatation of the pelvis and calices and an apparently normally functioning renal parenchyma. The establishment of renal drainage might have been as satisfactorily accomplished in this case by primary removal of the obstructing lesion (a calculus), but I have operated in cases in which it became necessary within a few days to remove the kidney because it was seriously infected.

*Whether to Remove the Obstructing Lesion or Perform Nephrectomy or Nephrostomy?*—In general, it may be said that when enough renal parenchyma remains to justify the assumption that it is worth preserving, the proper surgical procedure should be directed toward relief of the obstruction and preservation of the kidney. This may be accomplished best by the removal of the stone or stones, performing at the same time temporary nephrostomy to assist in more perfect drainage. Such procedure should be carried out particularly if the obstructing calculi are within the kidney or in the upper portion of the ureter so that the kidney is made easily accessible for nephrostomy.

On the other hand, when the completely obstructing lesion is in the lower part of the ureter, and an emergency operation is necessary, nephrostomy may be the simplest and safest procedure until the condition of the patient improves to the extent that the removal of the obstruction can be carried out safely later, when the toxæmia has subsided. For example, in one case a small left ureteral calculus became impacted in the lower portion of the ureter subsequent to an unsuccessful attempt to remove it by manipulation of a catheter through the cystoscope. Intermittent fever and prostration necessitated immediate relief of the obstruction. The small size of the stone, its situation in the vesical portion of the ureter (the most difficult site for surgical removal of a small stone) indicated the advisability of draining the kidney. This was successfully accomplished by temporary drainage of the renal pelvis; the patient's fever subsided, his general condition improved, and when the toxæmia had disappeared, the stone was successfully removed by catheter.

When renal parenchyma is involved to the extent that cortical abscesses have formed, nephrectomy may be necessary, even life-saving, especially if there is evidence of the presence of bacteræmia. In the absence of systemic infection, provided sufficient renal parenchyma remains, one is impressed with the satisfactory restoration of renal function and the subsidence of infection which occurs following removal of obstructing renal calculi and complete drainage of the kidney by temporary nephrostomy. Such methods have been of great value in the treatment of multiple, renal, bilateral calculi which produce infected hydronephroses, as illustrated in the following case.

Both kidneys of a woman, aged thirty-nine years, were obstructed by multiple calculi to the extent of causing infection in the hydronephrotic sac, and fever of 104° F. Marked tenderness to pressure was noted about and over the right kidney and infection to the perirenal tissues was extensive. Right pelviolithotomy was done, with removal of seven stones, the largest of which was 4.5 centimetres in diameter. The cortex was infected, and creamy, purulent urine spurted out under great pressure when the pelvis was opened. Two months later, a similar procedure was carried out on the left kidney. The nephrostomy catheters were removed and the patient recovered satisfactorily. In spite of the fever and the apparent disturbance of renal function prior to operation, the patient did not appear to be toxic, and the blood urea was within normal limits. Such factors in these cases must be of considerable prognostic significance.

In one case in which the obstruction was due to two stones in the right ureter,

multiple small cortical abscesses were present in the kidney without producing evidence of systemic infection. After removal of the stones and drainage of the kidney by allowing the incision in the ureter to remain open temporarily, function of the kidney was restored to the extent that two weeks later the incision had healed and the kidney was outlined and excreting a moderate amount of skiodan. In other words, a badly infected kidney containing cortical abscesses usually should be removed, particularly if systemic infection is apparent, provided the condition of the other kidney is adequate to carry on renal function. One is tempted to preserve such a kidney when systemic infection is not present, especially if the condition of the opposite kidney is uncertain.

*The Effect of Ureteral or Renal Obstruction on the Solitary Kidney.*—A normally functioning kidney will maintain adequate function even in the presence of complete obstruction of the other kidney. Any evidence of renal insufficiency in a case in which obstruction of but one kidney is apparent indicates that the function of the other kidney probably is not adequate, and hence every effort must be directed to relieve urinary obstruction without sacrificing the obstructed kidney. Hence, when in doubt, perform nephrostomy rather than nephrectomy.

I observed noteworthy exceptions to this rule in a case of perirenal accumulation of urine following the rupture of a hydronephrotic kidney, the parenchyma of which had become infected. The clinical picture was that of peritonitis, except for extreme tenderness on pressure over the left kidney. The concentration of urea of 180 milligrams in each 100 cubic centimetres of blood was apparently due to the intestinal stasis secondary to the retroperitoneal infection, or to protein destruction (the amount of urea was greater than normal; 117 grams passed in the urine each twenty-four hours). Following nephrectomy and drainage, the patient continued to improve, and he recovered completely, which would not have been the case had function of the opposite kidney been inadequate.

Another important exception occurs in cases in which a stone or stones in one kidney may interfere temporarily with its function so that an acutely obstructing lesion of the opposite kidney or ureter may be accompanied by anuria, yet after the removal of the stones function of both kidneys returns.

In one case, that of a woman, a large stone suddenly obstructed the right ureter and the patient became anuric. Röntgenograms disclosed this stone, and two stones in the left kidney. Anuria had been present for twenty-four hours prior to examination. The concentration of urea was eighty-four milligrams in each 100 cubic centimetres of blood; pus and blood were found in the urine. A catheter was inserted up the right ureter past the stone, which temporarily relieved the obstruction of the right kidney. An intravenous urogram disclosed right hydronephrosis with stone in the right ureter. The left renal pelvis or ureter was not visualized. Stones occluded the left renal ureteropelvic juncture. Right ureterolithotomy was performed October 6, 1932, and approximately a month later, left pelviolithotomy. Two stones were removed, one 3.5 by 2.5 centimetres and the other 2.5 by 1.5 centimetres, from the left kidney, the renal parenchyma of which appeared to be reasonably normal. An uneventful convalescence followed. November 24, 1932, the blood urea was normal. An intravenous urogram disclosed dilatation of the right pelvis and calyx, graded 3, and dilatation of the left pelvis and calices, graded 1. In commenting on the urogram, Braasch stated: "Remarkable restoration of function of left kidney following pelviolithotomy." This would lead to the assumption that a stone or stones in a kidney may temporarily interfere with its function without permanent injury of the parenchyma of the kidney, and the kidney itself might be said to be resting.

*Perinephritic Abscess.*—Irregular fever, tenderness and induration in the perirenal area, leucocytosis, röntgenological evidence of scoliosis, and obliteration of the outline of the ileopsoas muscle on the tender side, is the clinical syndrome indicating perinephritic abscess, and exploration of the perirenal region is indicated. I can recall scarcely a case in which exploration on such evidence did not reveal abscess. Secondary nephrectomy is seldom necessary in such cases. When to perform nephrectomy can be determined by observing the degree of infection and function by cystoscopy or urography prior to or following drainage of the abscess. There is always the slight possibility that an abscess about the left kidney may be due to retroperitoneal extension of an infected carcinomatous growth of the descending colon. I have operated in two such cases, in both of which a diagnosis was made on microscopical examination of the removed tissue but only after secondary exploration of the persisting sinus.

*Intrarenal Hæmorrhage.*—In general, although intrapelvic renal hæmorrhage occurs when tumors are present in the kidney, it is seldom if ever necessary to perform emergency nephrectomy because of sudden serious hæmorrhage due to such a cause. There may be serious bleeding from the kidney or ureter subsequent to operation on the renal parenchyma, such as nephrolithotomy, and in rare instances following pelviolithotomy or ureterolithotomy.

Such a complication occurred in one of my cases following simple pelviolithotomy, and secondary nephrectomy was necessary; the kidney contained multiple renal infarcts. In another case serious bleeding followed removal of a gauze pack, inserted into the renal substance around a large de Pezzar catheter to control bleeding from a large opening made in the parenchyma of the kidney to remove an egg-shaped stone measuring five by four centimetres. The bleeding was successfully controlled by mattress sutures in the renal parenchyma. In a case in which I removed a very large stone from the lower third of the right ureter, there was rather serious bleeding from it into the bladder. Evacuation of blood-clots in the bladder through a cystoscope had no effect on the bleeding. The bladder was opened, and a No. 14 urethral catheter was passed up the ureter. At a point above the approximate area from which the ureter had been incised for the removal of the stone, considerable turbid urine was encountered. The obstruction caused by the blood-clots in the lower part of the ureter, distal to the ureterolithotomy incision, was relieved, and bleeding from the ureter ceased spontaneously within a few hours.

In the case of a patient, aged sixty-four years, from whom I removed a large, solitary, renal cyst, bleeding into the renal pelvis was continuous and necessitated nephrectomy seven days later. Although healing was excellent at the site of the resection, large sclerotic branches of the renal artery were found and apparently explained the cause for bleeding, the corollary of which would seem to be that plastic operation on the renal parenchyma of an elderly patient with arteriosclerosis may not be successful.

Another condition in which intrarenal hæmorrhage may occur and necessitate immediate surgical interference is polycystic kidneys in which massive hæmorrhage may occur into the cysts either spontaneously or the result of trauma to the kidney. In such cases, nephrectomy may be advisable if the function of the opposite kidney is adequate; if not, the operation described

by Rovsing of puncture collapse of the cysts or enucleation is surprisingly successful in prolonging life in many cases.

In a group of eighty-three cases in which operation was performed at The Mayo Clinic because of symptoms developing from polycystic kidneys, nephrectomy was carried out in thirty-one, usually because of severe infection. The Rovsing operation or excision of some of the cysts was performed in twenty-nine cases, with an exceedingly low mortality rate and with surprisingly long periods of life in many cases. The most important factor in the determination of the choice of the Rovsing operation or nephrectomy, as one would expect, depends on the function and degree of infection in the kidney operated on, but especially on the ability of the remaining kidney to carry on adequate renal function.

*Injury to the Kidney Producing Intrarenal and Perirenal Hæmorrhage.*—I shall refer only briefly to the indications for emergency surgical procedures in the treatment of the contused or fractured kidney. In general, it can be said, however, that many contused kidneys heal spontaneously. Rupture or tearing of the renal vessels necessitates immediate nephrectomy and tearing of the renal pelvis necessitates perirenal drainage. Intravenous urography has been of great aid in localizing the point of fracture. As a rule, when the condition of the patient indicates accumulation or extravasation of either blood or urine about the kidney, or continuous bleeding into the urinary tract, producing general symptoms of progressive, depleting hæmorrhage, surgical exploration of the kidney should be carried out.

*Summary.*—Emergency operations on the kidneys and ureters are usually performed because of obstructing lesions interfering with the adequate passage of urine. The association of renal infections with obstruction produces symptoms characteristic of toxæmia, the result of pyelovenous backflow or absorption of toxins and bacteria from severe cortical infections, usually with abscesses.

Striking examples of the restoration of renal function after the removal of renal and ureteral calculi and complete drainage of the kidney by temporary nephrostomy are convincing arguments in favor of such conservative methods of caring for such lesions, rather than treatment by nephrectomy. This is true in most cases even when there is considerable infection within the renal pelvis (infected hydronephrotic sac) and occasionally within the renal parenchyma. However, if the kidney is producing general evidence of severe infection and toxæmia, and the opposite kidney is normal, immediate removal of the kidney is usually essential to the recovery of the patient.

One normally functioning kidney will maintain adequate renal function in the presence of complete obstruction of the other kidney. Hence, any evidence of renal insufficiency in such cases indicates that the function of the other kidney is not adequate. There are a few exceptions to the rule, but when in doubt nephrostomy rather than nephrectomy is the advisable procedure.

Perinephritic abscess is characterized by a typical clinical picture consisting of pain in either renal area, fever, leucocytosis, tenderness to pressure, and in most cases by scoliosis with obliteration of the line of the ileopsoas muscle on Röntgen examination. Surgical exploration of the perirenal region in such cases is always advisable.

Intrarenal hæmorrhage requiring emergency surgical procedures is of infrequent occurrence, but may occur in cases of traumatic fracture of the kidney or its vessels, or rarely following operations on the kidney.

Discussion.—Dr. William F. Braasch (by invitation) (Rochester, Minn.) noted that adequate drainage can frequently be established by means of the ureteral catheter. Furthermore, nephrostomy or pyelostomy will give the desired drainage. With acute cortical infection, however, neither catheter drainage nor nephrostomy will correct the condition and immediate nephrectomy is advisable. If on exploration of the kidney many small abscesses are found scattered over the entire kidney, the question may well be asked, if the other kidney is similarly affected would nephrectomy be advisable?

The clinical diagnosis of cortical infection may be difficult. Often the evidence of toxæmia is the best guide. The patient has a toxic appearance and will complain of headache and stupor. There may be no localized tenderness or pain in the region of the affected kidney. A blood culture may be of considerable aid, but often one does not want to wait twenty-four hours for the report. He had frequently seen blood cultures that were quite unsatisfactory. In some cases the report would suggest the possibility of contamination and it would be necessary to wait another twenty-four hours. He had also observed negative blood cultures where he knew there was a systemic infection.

In cases of doubt it would be conservative surgery to take the kidney out in order to prevent the possibility of secondary infection via the blood-stream going to the other kidney.

This course would be preferable to waiting until the other kidney becomes involved as shown by increase in blood urea and death. On autopsy cortical infection is usually found in the other kidney, which often would not have occurred if the primarily infected kidney had been removed earlier.

Another phase which both Doctor Walters and Doctor Beer brought up is that they have demonstrated how dependent we are these days upon intravenous or excretory urography. The general surgeon has been very slow in adopting this most valuable adjunct in the diagnosis of renal conditions, probably for various reasons. One reason is that he apparently felt it was within the exclusive province of the urologist. The speaker did not think it is at all. Intravenous urography is a method of general diagnosis and should be employed more generally, and undoubtedly will be in the future. The only difficulty is the matter of interpretation. With increasing familiarity with interpretation of the intravenous urogram, the method will be employed in routine differential diagnosis of abdominal disease. More and more diagnoses are being made by the country practitioner by means of this invaluable method.

There are, however, some complications involved in its universal use. There are many difficulties in the way of accurate interpretation. It will also be found that data given by the cystoscope will often be necessary. Among the difficulties in interpretation is the absence of visualization caused by reflex inhibition of excretion, which was emphasized by Doctor Walters and Doctor Beer. In some cases with renal stone it is curious to see how the kidney will show absolutely no visualization in the excretory urogram, while the other kidney is clearly visualized. On surgical exploration the kidney involved is often found to be normal. It is difficult to explain this on physiological grounds, but it is apparently the result of temporary inhibition of excretion or the result of irritation from the calculus.

The method has proven to be of great value in our evaluation of post-operative results. He would give warning, however, that one should not expect too much from intravenous urograms made within a week or ten days after operation on the kidneys. A reflex inhibition of excretion often persists for several weeks. If taken in two weeks or a month later most interesting data are often available, which could be acquired in no other way.

Intravenous or excretory urography will be of greatest value to the surgeon in the interpretation of X-ray shadows, in determining the position of the stone in the kidney, and in ascertaining the function of both kidneys. Next in importance will be its aid in the demonstration and visualization of stasis. In those two things it will be unquestionably of great value to the general man. It will also be of great value with injuries to the kidney. We have been able to determine not alone rupture of the kidney but also its degree, from the evidence of extravasation of urine into the surrounding tissues. Rupture of the bladder is much better demonstrated by means of the intravenous cystogram than in any other way. In this way the danger of ascending infection from catheterization is obviated.

Doctor Beer said, in closing, members of this society are doing kidney surgery. Doctor Walters and Doctor Braasch have just called attention to a possible pitfall which would mislead the uninitiated to take out a kidney which is obstructed by a stone in the ureter. It has been known for years that a stone in the ureter may inhibit such kidneys. A catheter passed up to the stone may fail to collect a urinary specimen and one would have the impression that the kidney was definitely not functioning. As a matter of fact, an intravenous urogram in many of these cases may show that there is no function. The general surgeon might, not knowing this pitfall, cut down on the kidney to inspect it and perhaps remove it.

He thought the rational thing to do in these cases of so-called "resting kidney," or "hibernating kidney" is to take out the obstructing stone. He did not believe they are either resting or hibernating, but are secreting all the time though one cannot collect a specimen. He had made use of intravenous indigo on the table in this case and passed the catheter up to the pelvis, through the ureterotomy incision, and obtained good indigo secretion while the patient was still under the anæsthesia. In other words, the kidney was proved to be functioning well, though they were not able with their methods to collect specimens below the stone.

Every abdominal case that is not clear-cut should have a flat plate, an intravenous urogram, a gall-bladder series and then a gastro-intestinal series so as to clear up the three tracts in the abdominal cavity with which one has to deal and which one has to treat.

# ANATOMY ECLIPSED

By David Cheever, M.D.
of Boston, Mass.

When a source of light which for ages has illumined our steps is eclipsed by another celestial body, it is natural that we should feel disturbed, and even though the newcomer has a radiance of its own, that we should inquire whether we are better or worse off, and whether we might not have the benefit of both luminaries to make clear our perilous path. That the anatomy of the medical curriculum has suffered a partial eclipse, and that its obscuration is increasing are so evident that it is incumbent on those charged with the responsibilities of medical education, as are the Fellows of the American Surgical Association, to examine the situation and register their approval or disapproval of the change which is taking place.

If a text were needed to introduce this subject, it might well be taken from Thomas Vicary, who in 1577 wrote or published the first book on anatomy in the English language. Said Vicary: "The Chirurgeon must knowe the Anatomie, for all authors write against those surgeons that work in man's body not knowing the Anatomie: for they be likened to a blind man that cutteth in a vine tree, for he taketh away more or less than he ought to do." Quaint and old-fashioned this sentiment sounds, yet most medical men, and their patients also, I fancy, would recognize in it a principle, fundamental and as immutable as anything can be in this changing world.

From the beginning of organized medical education until a period within the memory of living men, anatomy was not only the fundamental, but the sole laboratory subject. The study of form and structure must precede that of function, and both together must be antecedent to the study of perverted form and function—in other words, of pathological anatomy and physiology. These elder daughters were long the chief support of Mother Medicine's family, but she has been prolific, and many other offspring have been born; the end is not yet, and these newcomers are lusty youngsters who, like most self-confident adolescents, are not conspicuously aware of the rights of others, and are apt to crowd and jostle their elders as they seek their rightful places in the sun. The two younger of the elder trio, pathology and physiology, are still growing, the latter indeed with no evident slackening of pace; the eldest, however, is quite matured and though just as useful as ever in the family economy, is thought by some to be old-fashioned and out-of-date and is in danger of being neglected. She has children of her own, by the way—first, histology and embryology, and then a flock of later arrivals such as comparative morphology, cytology and experimental embryology, all promising youngsters who are adding much to the family reputation, but who are necessarily crowding the old home and claiming all of the family income they

can get. And unfortunately the eldest sister, anatomy, cannot be dispossessed, because though neglected, she is perfectly certain to live just as long as Mother Medicine herself.

No intelligent man, even a jealous lover of anatomy, can deny that the newer sciences, as they crowd into a curriculum which has about reached its limit of accommodation either by extension of time or by a tabloid-like compression of substance, have in general established their claim to receive every reasonable consideration. Anatomy, having once and for a long period comprised the whole of the science underlying the art of medicine, finds itself of much less importance *relatively*, but is its value not just as great as ever *intrinsically*? The student in the dissecting room enters upon a discipline of incalculable value, where not only the knowledge gained is an end in itself but where the method used requires that he become an independent investigator, training both his senses and his faculties of observation and acquiring skill in the use of instruments. Says Macalister: "I believe that training in careful dissections is still the best discipline," if the student is "not willing to accept the words of the text-book until he verifies them by comparison with the facts."

Who shall teach anatomy? Formerly the chairs of Anatomy and of Surgery were combined and held by the most conspicuous practitioner of the community; later the chairs became distinct although the Professor of Anatomy was usually still a man in active practice; finally, since the growth of the full-time principle in laboratory and even in clinical subjects, the anatomist in the most richly endowed schools has become a pure laboratory worker, with no clinical contacts, and sometimes even without the experience gained from a hospital interneship, if indeed he ever studied medicine at all! His assistants of varying grades, depending on the ability of the school to pay full-time salaries, are likely to consist of one or several men preparing themselves for advancement in the same path trodden by their chief, and of a larger number of young men in active practice, who see in the part-time job as assistant in the dissecting room, ill-paid though it be, an opportunity worth taking for a year or two, of brushing up their anatomy and trying themselves out as teachers. It is idle to pretend that as a rule the men who seek these minor posts are the equal of their fellows of former years, when the pick of the young men in a medical community who nursed high ambitions to excel in surgery competed for such positions and found in long-continued work in the dissecting room an experience which made them competent, safe, and daring in the performance of surgical operations, and was the surest way of attaining preferment alike in clinic, in practice, and in surgical teaching. Any of us who were educated in the " 'nineties" need only to think of our instructors in anatomy to be reminded of the surgeons who became leaders in our communities.

Related to the question as to who shall teach anatomy, and how, is the query as to just what anatomy shall be taught in the regular curriculum. It is the fashion to disparage systematic descriptive anatomy, and certainly

there is scarcely any subject in which it is more important for the teacher to have a knowledge of the values and perspectives, the lights and shades, of his subject. It is dangerous, however, to assume that anything in gross anatomy is unimportant, for the development of surgical therapeusis shows a constant trend toward appropriation of new fields where an accurate anatomical knowledge is indispensable. An obvious example is furnished by the sympathetic and parasympathetic nervous systems: largely neglected in our day because their function was ill-understood and the relief by surgical measures of their dysfunction was not attempted, but now the subject of an enormous literature and of numerous operative procedures. Another example is the skeletal muscular system—we will all agree that a meticulous knowledge of the exact origin and insertion of each of the 500-odd skeletal muscles is unnecessary, but we must also own that a good working knowledge is essential in the diagnosis and treatment of fractures and in the muscle and tendon transplantations so skilfully used by orthopædists for the relief of paralyses and contractures. Still another instance is the accurate and comprehensive knowledge of morphological osteology and of visceral topography which is needed by the radiologist for the interpretation of films. The internist who makes lumbar, cistern, and sinus punctures, performs paracentesis on pleural, pericardial and abdominal cavities, does vein-puncture and intramuscular injections, needs much beside the accurate knowledge of visceral topography which has always been essential to him. In fact, whatever the relative importance of gross anatomy in the hierarchy of medical studies, it becomes steadily of greater intrinsic value with the advance of medical science.

There are arguments, or rather assertions, to the contrary. We are all familiar with the sage who says that a surgeon can learn all the anatomy he needs on his patient—all *he* needs perhaps, might be rejoined, but not all the patient needs! Maurice H. Richardson, a former President, said before this Association in 1902: "I have heard a surgeon of large experience say that a knowledge of anatomy is bad for the abdominal surgeon because it makes him timid;—it makes him bold! *He* can be bold and rapid if need be, when the man who despises anatomy could without disaster be neither." It may be true, of course, that in this era of intense specialism, surgeons who prefer and find themselves able to confine their work to a topographically small anatomical field gain by intensive study and experience during postgraduate years, whatever knowledge of anatomy they require, unless indeed, an unkind Fate introduces, as she may now and then, a complication requiring prompt action in an unfamiliar field. The plea of the specialist, however, is hardly justification for cutting down the required anatomy at the beginning of a student's career! As well debar a youngster from learning to write because he may employ a stenographer when he is grown up!

Opportunities other than in first year descriptive anatomy are offered in many schools, as for example exercises in topographical anatomy, which differ from the descriptive ones only in method, and courses in surgical or applied

anatomy, which are frequently offered, usually as electives or as voluntary extra work. A course in applied anatomy, given preferably by an experienced surgeon, may constitute the most important and significant experience of a student in the whole field of anatomy. Courses in operative surgery on the cadaver, given as they often were by surgeons and teachers of distinction, were of the utmost value in preparation for the surgery of the pre-Listerian era. But ligations of vessels in continuity, amputations, incisions of abscesses and removals of the breast constitute the least important part of the surgery of today. The cadaveric lack of bleeding, the absence of retractility and elasticity of the divided tissues—and the total absence in the cadaver of the conditions and difficulties which confront the surgeon when he invades the abdominal, thoracic, and cranial cavities impair seriously the usefulness of this discipline, which is afforded to much better advantage in the animal laboratory, or better still, in the apprenticeship under responsible supervision in a hospital interneship.

The study of anatomy is proverbially dry; the necessity of memorizing a great number of names, relations, forms and other facts at a time when the student has only the vaguest idea of their significance leads to boredom and lack of interest. If the systematic instruction is given by a professor who has no clinical experience, who knows only from hearsay—if at all—and is not concerned with the reasons why anatomical facts are of importance to the practicing physician or surgeon; whose real interest and enthusiasm lie in the field of comparative morphology or experimental embryology, it can scarcely be expected that the subject shall be presented in a stimulating, interesting and profitable manner. It is unwarrantable to assume that junior instructors, teaching in sections, ill-paid and lacking in experience as teachers, will assure the entire class of receiving what they ought to get from a senior member of the department.

The failure to teach the significance of gross anatomy instead of its bone-dry facts is well illustrated by some correspondence which may be summarized from the files of the ANNALS OF SURGERY. In June, 1926, Dr. Hermann Fischer, in discussing a paper by Dr. Fordyce B. St. John on biliary fistula, called attention to the troublesome character of hæmorrhage from the cystic artery and the difficulty of securing it. He described an effective method of controlling it by placing the left index finger in the foramen of Winslow and hooking up the structures (including the hepatic artery) which run in the free edge of the gastrohepatic omentum. He stated that he had not seen this simple method described in text-books. This communication inspired a letter from Dr. F. H. Parham, of New Orleans, which stated that in Surgery, Gynecology and Obstetrics for September, 1925, would be found an article by Dr. Duncan Parham describing in detail the same procedure "which had accidentally occurred to him in a demonstration on a dog," and the feasibility of which he further proved by animal experimentation. Subsequently, in an instance where failure to secure an anomalous cystic artery resulted in alarming hæmorrhage, he had successfully extricated

the patient from a dangerous situation by the same expedient. Doctor Parham further stated that a search of the literature failed to find any reference to such a manœuvre.

Is not this a deplorable state of affairs? Three highly competent surgeons had never been helped in their student and interne days to a realization of the practical significance of the course and relations of the cystic artery, to the end that the knowledge might be available in emergency. Is it not almost the sole reason why a student should dissect, examine and study the relations of the cystic artery that he may understand its significance in lesions of the gall-bladder and ducts, and be able to avoid or discover it, or control accidental hæmorrhage from it if wounded?

It is interesting to inquire just who is teaching anatomy in our schools. Examination of the latest announcements of fifteen institutions which would, by common consent, be ranked as leaders in medical education, shows that in the majority the teaching is under the direction of laboratory anatomists who hold no degree in medicine, or who if they do, have had little or no clinical experience. In most instances the heads of the departments teach the branches of embryology or histology or both. In two schools the teaching of gross anatomy is entirely in the hands of Doctors of Philosophy and Bachelors of Science; in four the preponderance of this element is very great, constituting approximately three-fifths or four-fifths of the teachers of professorial calibre. It is relatively uncommon to find men in the higher grades who, if they have degrees in Medicine, have also important clinical experience. In one school are found three full professors in the fields of comparative anatomy, embryology, histology and cytology, not one of whom has ever seen a sick person since he graduated in Medicine; the gross anatomy is in charge of an Assistant-Professor—competent indeed, but so ill-paid that his time and energy must be largely devoted to earning his living by other means. In one school there appears to be no requirement that the gross anatomy of the entire body be systematically taught, though an examination in the subject must be passed. In another school the dissection of the extremities is optional, leading to the inference that its graduates had better be excused from treating conditions other than those affecting the trunk, head and neck. It is understood, of course, that in almost all of these schools there is oversight and quizzing in the dissecting room by young clinicians but it is only too certain that these men receive but pitiful compensation—so small that only the rare man can feel much obligation to or enthusiasm for his job.

No doubt it has become difficult to find able clinicians to teach anatomy, but one reason is not far to seek. The gross anatomist, susceptible to neuroses like any one else, has developed an inferiority complex. It is not helpful to him to be told by a full-time (and fully paid!) colleague in a younger and still adolescent pre-clinical department that anatomy is dead and unworthy of so prominent a place in the curriculum. Harvey Cushing has said: "More and more the pre-clinical chairs in most of our schools have come to be occupied by men whose scientific interests may be quite unrelated

to anything that obviously has to do with Medicine, some of whom, indeed, confess to a feeling that by engaging in problems that have an evident bearing on the healing art they lose caste among their fellows." It tends to create a sense of frustration in the morphological and clinical anatomist to learn from the pen of the Professor of Anatomy in one of our most conspicuous and richly endowed schools that the subject of the former's study and teaching is nothing but "fixed protoplasm," that "human anatomy was in great danger of becoming nothing more than a handmaid to Medicine and Surgery"—and that "the days when the anatomist commanded the respect and confidence of his medical colleagues solely on the basis of his knowledge of static morphology, are rapidly disappearing." Until enlightened by these pronouncements as to his true status, the anatomist had labored under the delusion that he was studying and interpreting the architecture and adaptation to function of the most marvellous of created beings; that in so doing he was laying with his students the very foundations of the science and art of healing which they were to practice; and that in proportion to his learning and zeal and devotion to his work he deserved and received the respect of his fellows. If the views above quoted, circulated by the most powerful of the Foundations in the field of education, represent truly current opinion and practice, it is difficult to escape the conviction that the young surgeon, eager to enter a profitable field of teaching, to make himself serviceable, to win esteem and the preferment justly due to meritorious service, would do well to hesitate before he commits himself to more than a year or two, if even that, of anatomical teaching. He may ponder and believe the words of Richardson: "Prolonged dissection on the cadaver is the only real preparation for operative surgery," or the declaration of Cushing: "I would say spend four years in three places—the dissecting room, the dead house and the clinic; these places represent the workshops of the three fundamental subjects from which all others have branches off, . . . and yet they have come to be neglected";—and yet again would hesitation on his part be prudent.

A phenomenon which obtrudes itself as an inevitable corollary of the eclipse of anatomy is the apotheosis of research. Research practiced by the genius or even by the merely talented, yielding, as the Fates may ordain, its grains of gold for the fashioning of Truth, is indeed as nearly divine a work as human faculties can do, and deserves a place beside the gods. But much masquerades as research which resembles it only in name. Who will venture to say what proportion of the men who, attracted by the glamour and sometimes false prestige attending research, enter upon it, are really qualified by training, by ability, by opportunity and by singleness of purpose to pursue it? Prevailing currents of thought among medical educators and executives are largely responsible for the belief among young men that whereas the high road to success formerly lay through the dissecting room and the dead-house, now that route is out-moded and scarcely passable through disuse, and the new speedway is solely through the experimental laboratory. Moreover, is it not irrational and stupid that the concept of research should be identified

solely with the laboratory? Research is much more a state of mind than it is an overt act. The physician who, by observation and correlation of the phenomena of disease and by sound reasoning draws inductions which he marshals and presents in class or forum or journal for the guidance of others—is he not engaged in research? The surgeon who, on the most precious of living subjects, applies the principles of manual therapeusis, modifying and adapting his procedures to fit the infinite variations of disease which he encounters, and records his observations and results for comparison and evaluation with others—is he not engaged in research? Edward Jenner, the general practitioner, observing facts and making inferences therefrom, made a research which protected mankind from the scourge which had periodically devastated it; Sir James McKenzie conducted the most veritable piece of research in studying, recording, classifying the symptoms and signs of patients with disordered action of the heart, and contributed a concept of its pathological physiology which has been but confirmed by laboratory instruments of precision.

Is it unreasonable to declare that gross descriptive morphological anatomy is worthy of being taught by a man of seniority and experience in teaching, of wide clinical experience, preferably in surgery, and of broad interests in the whole field of medicine, especially the fundamental sciences? It is immaterial whether he be head of the department—a matter which should depend on the relative qualities of leadership and executive ability of members of the staff. He should have full professorial rank, befitting a teacher responsible for the instruction in a major fundamental subject. His emolument should be, in theory, equal to that paid full-time teachers of equal rank, but in practice, he may be able to carry on enough clinical work, perhaps only in the University Hospital, to permit some portion of his full professorial salary to be diverted to other uses. But his prestige and salary should be such as to make it worth while for a first-class man to give first-class instruction in the most fundamental subject of the medical curriculum. Such a man, with his knowledge of physiology, pathology and pathological physiology, of clinical medicine and surgery, will quicken the dry facts of anatomy with life, and inspire students with a realization of the practical importance of what they are studying. If time permits and a teacher is available to give supplementary lectures in a philosophical vein on the implications of human and comparative anatomy in the broader field of biology, by all means let these be given. Let the Medical School be permeated by the spirit of research, but let us have no research snobs—nor any others, for that matter; let us each respect the other's fields; let us consider the research conducted in the clinic as praiseworthy and fruitful as that involving test tubes and kymographs and manipulations of ova to make monsters of embryonic batrachians; let us believe that the prime duty of a Medical School, as contrasted with a University or Foundation Biological Institute, is to prepare men to practice the art of preventing and healing disease, and let us consider that duty as outranked in dignity by no other on earth.

DISCUSSION.—DR. HUBERT A. ROYSTER (Raleigh, N. C.) agreed with all that Doctor Cheever had said. He had had some experience on examining boards and had made some observations. He found that even in the high-class medical schools, and the highest ones especially, the subject of anatomy is not only neglected but is ill taught. There is an intensive course in anatomy lasting five months, beginning in October and ending in February, on which the examination in some of the schools is held at the end of the second year. The students are put into the dissecting room in these very high-class institutions without any instruction whatever, no text-book, no diagrams, no explanations except a few dissecting tools which are given to them and they are asked to dissect.

The student goes in, gets off the skin very well, but if he cuts the cutaneous nerve they swear at him. They do not, however, tell him where the cutaneous nerves are.

That may be the right way. At the risk of being old-fashioned and of joining in Doctor Cheever's well-rounded criticism, he finds the following objections to it:

First, there is an effort to make a research anatomist out of the freshman. It cannot be done, and it ought not to be done. One of the teachers in one of the high-class schools told him he did not care for a man to learn too much anatomy because he didn't think every freshman was going to be a surgeon. To that the reply was that it is equally important for the medical man to know his anatomy because the surgeon has the opportunity of going in and finding out. But regional anatomy, and even minute anatomy if known by the clinicians will make them better diagnosticians.

"But," said he, "I insist the best way for the student to learn his anatomy is in the third year at the post-mortem table." To that there is no reply.

He was not one of those who believe that the surgical anatomist is always the best surgeon, but he thought the anatomical surgeon is always the best type of operator.

If we stress the anatomical surgeon we are showing only what the ideal type of surgeon should be.

In his experience on examining boards, he had found that the lowest marks all over the country made in anatomy, both the practical and the written examinations, are made by the highest type of student graduating from the highest type of class A schools. Anatomy should be taught by anatomists and not by embryologists or simply scientific research workers.

DR. ARTHUR DEAN BEVAN (Chicago, Ill.) had taught anatomy for about fifteen years. He belonged to the Association of American Anatomists. Gradually, as medical education in this country was reorganized, the chairs of anatomy passed into the hands of embryologists and biologists and men who were devoting their entire time to research in anatomy. Most of these were, of course, excellent teachers, but gradually the old-time gross anatomist who made anatomy the stepping-stone of clinical work passed out.

At the Johns Hopkins University, Mall was a great embryologist. Mall's interest in anatomy was in anatomical research and his conception of gross anatomy was to give the student a cadaver and a book and let him work out his own salvation. The anatomy which the student and the medical man need in their clinical work cannot be acquired in this way. The student must be taught the kind of anatomy that he must know in his clinical work and the teaching of anatomy should be carried through the entire medical course.

He had frequently asked medical students of his own, in discussing a problem in which anatomy was very fundamental, "When did you look in an anatomy last?" The answer often was, "I finished anatomy last year or two years ago." Of course, that is the wrong conception. If Langenbeck did any great service—and he did a very great service—he taught Billroth and the men who followed him that surgery was based upon anatomy and physiology and pathology. Billroth carried that conception throughout his teaching, and the Langenbeck and Billroth school continue strong.

He had in his surgical department always insisted upon carrying these fundamentals through the third and fourth years. He did not know just what position the teacher of surgical anatomy should occupy but he thought probably the best solution was to have applied anatomy taught by the department of anatomy in the first and second years and the department of surgery in the third and fourth. McLeod brings up this same idea very well in his physiology and biochemistry as applied to medicine. One should realize more and more the importance of showing the student the relationship of these fundamentals right from the beginning of their medical studies.

He agreed perfectly with what Doctor Cheever said about research. Laboratory research is not the only research. He said we are all doing research work. Clinical research is quite as important as laboratory research. In some ways, it is the most important research that is done in medicine. Certainly research on a man is no less scientific than research on the guinea-pig.

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